Economic evaluation and decision making for quality improvement in complex community health systems

'Thesis submitted in accordance with the requirements of the University of Liverpool for the degree of Doctor in Philosophy by Meghan Bruce Kumar.'

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By: Meghan Bruce Kumar

Abstract

Community health is a fundamental part of many healthcare systems and is widely advocated as a means to increase access to and coverage of health services, yet the quality of care in large-scale community health programmes is mixed. Quality improvement (QI) approaches are now being tested in community settings and there is limited evidence that integrating QI approaches can underpin success of community programmes. However, how best to measure that success and the cost and value thereof to the different decision makers in complex community health systems is not yet known.

This thesis provides the first economic evaluation of QI in community health systems, linking this to an exploration of decision making that includes an assessment of how economic evidence like this is used. Using an interdisciplinary mixed methods approach, I worked across several countries (Ethiopia, Kenya, Indonesia, Malawi, and Mozambique) to provide evidence to inform policy decisions. I first examined the costs of a QI intervention in all five countries and then used those data as the foundation of a cost-effectiveness decision tree model for the intervention in Kenya. Through interviews with national and global decision makers, I qualitatively examined the use and value of evidence in community health programmes. I present the results in a series of three related publications, linking them together with a literature review and discussion that show how these studies build upon each other and what they add to the existing evidence base.

This thesis shows that QI for community health is a good investment contingent on an existing cadre of community health workers. The budget impact of the QI intervention is low (less than 0.53% of general government health expenditure) and the modelled cost-effectiveness yields an incremental cost-effectiveness ratio of US$249.43 per disability-adjusted life year. The absolute costs are highly dependent on context and the intensity of the intervention. Qualitative findings indicate that decision makers are not satisfied with existing evidence and have limited capacity to assess its relevance for their settings and perspectives. As a result, power and politics fill this evidence gap.

Evidence must be at the heart of decisions in funding universal health coverage for them to be sustainable. To achieve this, the global community must strengthen the relevance of evidence and build the capacity of decision makers to understand and apply it. For a complex system, useful evaluation should describe context and mechanism of an intervention, estimate the effect size on both programmatic and health impacts and accurately reflect the opportunity costs.

Declaration

I, Meghan Bruce Kumar, declare that the work in this thesis is my own under the supervision of Drs. Miriam Taegtmeyer, Jason Madan and Edwine Barasa. At no previous time was this work submitted for a degree or qualification.

Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

For published and submitted material written with other co-authors, I have received written permission from each co-author to reproduce that material here, provided in Appendix 6.

Meghan Kumar

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List of acronyms

ANC	Antenatal care
CEA	Cost effectiveness analysis
CHEERS	Consolidated Health Economic Evaluation Reporting Standards
CHEW	Community health extension worker
CHV	Community health volunteer
CHW	Community health worker
CTC	Close-to-community
DALY	Disability-adjusted life year
DHIS	District Health Information Software
DHS	Demographic and Health Survey
FGD	Focus group discussion
GDP	Gross Domestic Product
GGHE	General government expenditure on health
EE	Economic evaluation
HIV	Human Immunodeficiency Virus
HSS	Health system strengthening
ICER	Incremental cost-effectiveness ratio
IDI	In-depth interview
IRB	Institutional review board
KII	Key informant interview
KQMH	Kenya Quality Model for Health
LMIC	Low- and middle-income country
LSTM	Liverpool School of Tropical Medicine
LVCT Health	Liverpool VCT Health (NGO)
MoH	Ministry of Health
NGO	Non-governmental organization
PDSA	Plan-Do-Study-Act
QALY	Quality-adjusted life year
QI	Quality improvement
RCT	Randomised control trial
SBA	Skilled birth attendance
SDG	Sustainable Development Goal
SQALE	Sustaining Quality Approaches for Locally Embedded Community Health Services
UHC	Universal Health Coverage
USAID	United States Agency for International Development
WHO	World Health Organisation

Commonly used terms and definitions

Term	Definition
Close-to-community (CTC) providers	Captures a variety of lay health workers with different responsibilities, training, and professionalisation in different countries. In all study sites, they are administered by the public health sector staff and cover at least maternal health and health promotion activities. Specifically, those studied are: Community Health Extension Workers (Ethiopia), *puskesmas* midwives (Indonesia), Community Health Volunteers and Extension Workers (Kenya), Health Surveillance Assistants (Malawi), Agentes Polivalentes Elementares (Mozambique).
Complex adaptive system	A complex adaptive system is a non-linear, dynamic system that evolves over time and may contain feedback loops. Here, refers to the community health system in each country as well as its interfaces with the wider professional health sector and the community.
Contextualisation	Modifying an intervention to suit the environment in which it works
Costs	Resource requirements for implementing an activity or intervention. These may include both financial or monetary resources as well as non-financial inputs such as time, which can be valued financially for comparison purposes.
Cost-effectiveness analysis (CEA)	A sub-category of economic evaluation. Can be measured in different units; here I focus on costs in dollars and effects in disability-adjusted life years (DALYs).
Decision maker	The person or group who chooses between options; a level above stakeholder. Intended user of evidence. In this work, I refer primarily to policy and financing decision makers.
Economic evaluation	Comparison between the resources required to implement an intervention and the outputs or benefits obtained as a result; cost-effectiveness analysis is one type of economic evaluation.
Embedding	Adoption of an (external or new) intervention or individual into routine organisation workflows, structures and financing, usually aiming for sustainability.
Fidelity	Level of alignment of implementation in the field with the design or planned version of an intervention. Related to contextualisation.

Term	Definition
Generalisability	The application and relevance of findings from a sample or study population to a wider population or context
Health Systems Research	Research focusing on the societal organisation, policies, and actors rather than clinical or basic science aspects of health and health care
Implementation research	Experimental work in a 'real world' setting that allows understanding of operational, financial, and/or capacity challenges
Outcomes	Results of implementing an intervention or activity. May include health and non-health impacts but are usually valued in terms of health benefit in this sector. May be positive or negative.
Plan-Do-Study-Act (PDSA) cycles	A non-proprietary simple approach to quality improvement that has been implemented in many sites, diseases and facility types - both in health and beyond.
Quality of care	A measurement of the degree to which health care meets standards and/or is likely to lead to the best possible health outcomes
Quality improvement (QI)	Management approach using local data to design, drive and measure change
Soft systems	A methodology used to model change in organisations; used in operations research for complex systems
Transferability	Description of whether study or sample findings can be applied in a different population or context. A generalisable study can also be transferable but is not always.

Acknowledgements

In this process of writing this thesis, I learned a lot, read a lot, wrote a lot and travelled a lot. In between, I was a wife, mother, daughter, choir director, baker, and mischief maker.

I'm proud to be the first in my family to earn a PhD (husband excepted) and hope this will inspire others to follow in my footsteps.

Special inspiration was taken from Anneke Osse, a good friend and champion of police reform, who passed away while on her PhD journey in 2019.

I would like to thank those in the REACHOUT family who supported me in so many ways – in helping with childcare, in helping understand country contexts more deeply, in friendships and professional collaborations that have spanned four continents and will sustain in years to come.

Thank you to my advisors: to Edwine, for always being just down the road and to be counted on for solid methodological advice. Your team has become a great resource to me as well. To Jason, for your grudging acceptance of advocacy and my spaghetti diagrams – and for tapas with a baby in Spain. To Miriam, who didn't hesitate to hire me even though I was across the world and six months pregnant – and who has always provided a supportive environment in which I could work and grow; this has often included her spare bedroom.

Thanks to my family: to all of you for understanding that I was doing something big, and for letting me be selfish and become a hermit sometimes. To my parents especially, for providing childcare throughout the long school holidays that punctuated this journey and for inspiration of what it means to lead a life in which one never stops learning. To my kiddos, Myles and Elwyn, for understanding that a Mommy does things like singing and writing as well as caregiving; also, for your terrible jokes; and for the perspectives you unfailingly provided. Lastly, thanks to Pratap – your unfailing belief in me ('mist' or 'mish' notwithstanding) has been the bedrock on which I have grounded myself when in danger of going off course. Though the help with visuals and references didn't hurt!

Love you all!

1. Introduction

This publication-based thesis represents a series of nested sub-studies that extend the planned generalisability and feasibility assessment of the REACHOUT consortium's locally-led QI intervention to an economic evaluation of the same, with consideration of the decision context for the economic evidence produced. First, I provide some context on quality of care in community health and the potential for investment in this area. In section 1.2, I provide the context of the REACHOUT consortium under which the sub-studies that make up this thesis were developed. Then, I present the QI intervention that was conducted in REACHOUT countries and evaluated in the thesis. Finally, I specify my role in the related studies and how the thesis work is differentiated from and builds on the consortium's work.

1.1. Community health and the ignored problem of quality

Community, or close-to-community (CTC), health workers have been a fundamental part of health systems recognized globally since the Alma Ata declaration in 1978 (1). In the intervening 40 plus years, the visibility and popularity of CTC health workers have ebbed and flowed alongside various health system strengthening and investment approaches, motivated both by domestic and international political and financing trends (2–4). Today, CTC providers are frequently promoted as the means by which health systems will finally achieve "health for all" or universal health coverage (UHC), under the umbrella of the United Nations' Sustainable Development Goals (SDGs), the latest iteration of the global commitment to this elusive objective (5–7).

Despite the lip service reliance on CTC providers to "reach the unreached" and improve equity in healthcare service access and provision, there is limited global agreement on defining the role(s) of CTC providers in a health system. Systematic reviews of definitions and categorizations have been made by several researchers; this list not exhaustive (8–11). Whichever categorization or typology is used, a clear definition of training, responsibilities, supervision is necessary to help define what is appropriate, high-quality care for each cadre of CTC health worker according to the policy and context of the system in which they work.

Across all typologies of CTC providers, what characterizes this group most strongly is their interface role between communities and health systems (12). At this interface, they work to humanize health systems and familiarize users with how a system works, helping individuals navigate as patients and empowering them to engage in healthy behaviours in their daily lives in the community. Through educating citizens about healthy lifestyles and supporting behaviour change in communities, the impact of this preventive care work is often unobserved and underappreciated in averted illnesses or deaths. For the health system, the CTC providers are a means of improving prevention and early case detection, helping to ensure that patients seek care early, manage chronic illness appropriately and are followed up when needed; in some settings, they also provide curative care. All these efforts can contribute to improving health outcomes.

However, without clarity on roles and responsibilities, it is difficult to define the quality of care that CTC health workers should provide. The SDGs (specifically, Goal 3.8: 'Achieve universal health coverage, including financial risk protection, access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all.') have explicitly clarified that UHC will not be achieved unless all people have access to *high-quality* healthcare services. And the interface role comes with tensions; as the CTC providers are viewed by communities as an extension of the healthcare system, there is understandable frustration for the users when these 'community doctors' cannot provide services due to limitations on their role by professional groups (e.g. no use of rapid diagnostic testing for malaria by CHWs in some countries due to laboratory pathologists' protests). At the same time, when they refer people to facilities, patients may find these facility-based services inaccessible or undermined by poor staff attitudes, stock outs and long waiting times. Similarly, facility-based healthcare professionals tend to discount the healthcare done at the community level (e.g. by ignoring referrals received from CTC providers or not feeding back the outcomes of patients referred). They generally have poor understanding of the role of CTC providers and so do not utilise them well.

Quality of care is challenging to measure and define for any part of the healthcare system; this issue will come up again in the thesis, including in sections 2.3 and 5.5.

At community level, the attribution and implementation challenges associated with quality measurement are multifactorial. First, health outcomes are downstream of the primarily promotive and preventive healthcare linked through a complex causal pathway of behaviour, systemic barriers and social determinants of health; second, appropriate referrals may or may not be taken up by patients to achieve timely diagnosis and treatment; and lastly, poor quality at the reference facility means that even timely care-seeking may not achieve good outcomes.

Yet even as quality is difficult to measure at a system level, locally-based quality improvement (QI) is an approach that has been shown to work across high- and low-income settings and in different health areas and levels of facility (13–15). Extension and adaptation of QI methodology to community levels in healthcare is still relatively new, and those testing this approach to date have limited its evaluation to feasibility testing or process evaluation and related methodologies, which have shown mainly positive results, e.g.(16–18).

For QI to achieve its intended aims at any level of the health system, it needs to move beyond its locality to work within existing health system structures and workflows, be sustainably financed, and ensure the capacity of individuals and teams to generate, analyse and use health data for change. In practice, this may mean using existing reporting tools, supervision mechanisms and even human resources. The combination of individual, team and system level capacity building combined with sustainability and institutionalisation is termed 'embedding' in this thesis (19,20). There is limited research moving a project-based approach in community QI to embed it in a health system where it has been tested, which this thesis begins to address. The fundamental barrier to embedding or sustaining community QI that this thesis speaks to is transitioning financing and implementation from external project funders to the national or local governments that manage health systems, which required a combination of robust economic evidence and a clear understanding of the benefits of QI within the decision making context.

1.2. The REACHOUT consortium

In January 2013, the REACHOUT consortium (21) was established with an aim of generating generalisable evidence on improving the equity, efficiency and

effectiveness of CTC health programs. The consortium was funded by the European Commission and was a partnership between the following eight institutions (locations): BRAC University (Dhaka, Bangladesh); Eijkman Institute for Molecular Biology (Jakarta, Indonesia); LVCT Health (Nairobi, Kenya); Liverpool School of Tropical Medicine (Liverpool, UK); REACH Ethiopia (Hawassa, Ethiopia); REACH Trust (Lilongwe, Malawi); Royal Tropical Institute (Amsterdam, Netherlands); University of Eduardo Mondlane (Maputo, Mozambique) over a five-year period (January 2013 – January 2018) [European Union FP7, grant agreement 306090] (21). The major objectives of the consortium were:

1. To build capacity to conduct and use health systems research to improve CTC services.
2. To identify how community context, health policy and interactions with the rest of the health system influence the equity, effectiveness and efficiency of CTC services.
3. To develop and assess interventions with the potential to make improvements to CTC services.
4. To inform evidence-based and context-appropriate policymaking for CTC services.

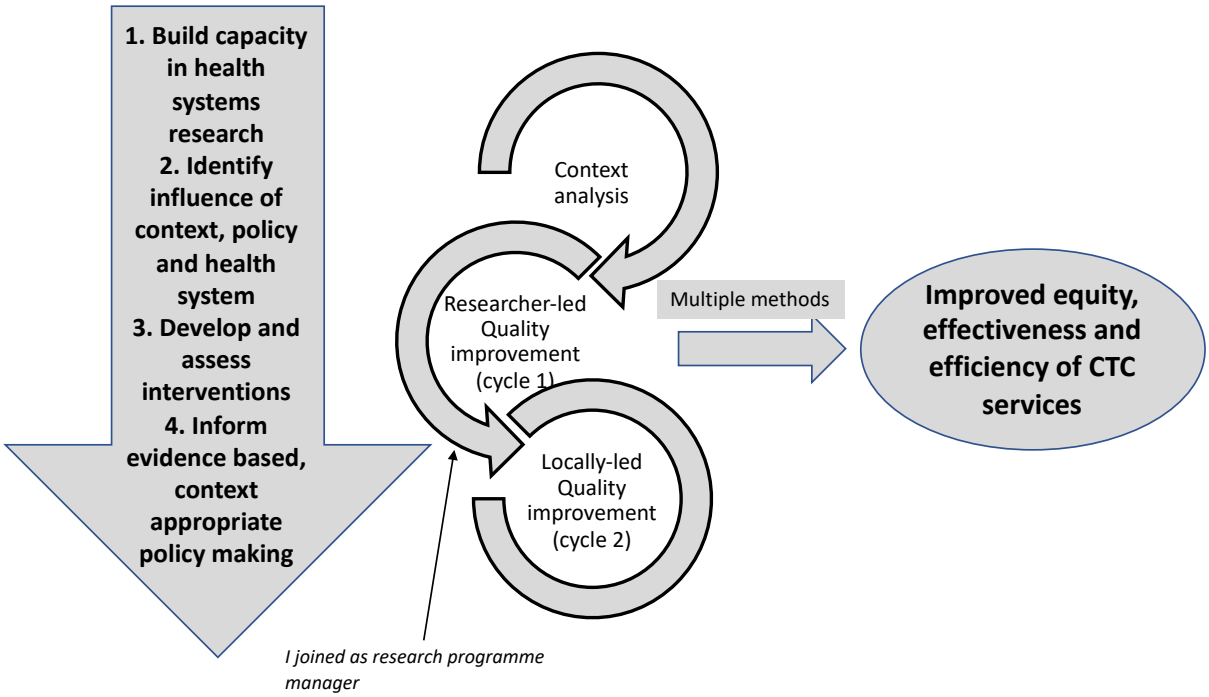


Figure 1.1: REACHOUT multidisciplinary approach to building local capacity for quality improvement in community health systems

Evidence was generated over five years in a phased approach as shown in Figure 1.1:

1) A detailed context analysis conducted over 18 months in each country site (22,23,32,33,24–31) combined with systematic review of the literature underpinned a conceptual framework on CTC provider performance (34), highlighting the complex interactions between system-, intervention-, and individual-level hardware and software components that affect performance (12). The context analyses yielded an understanding of the common barriers to quality of community health services that transcended boundaries, including:
    - Infrequent, fault-finding supervision
    - Poor or non-existent referral mechanisms and documentation linking to higher levels of the health system
    - Limited community engagement
    - Poor coordination of many actors (implementing and funding organizations)
2) Using action research approaches and in discussion with local stakeholders in each context (35–37), the consortium prioritized

supervision from this list as the quality problem to address in the first implementation phase of REACHOUT, also known as 'researcher-led QI'. It was dubbed 'researcher-led' because the problem identification, prioritization, and change plan development and implementation were done by the REACHOUT implementation research teams, while the targets of the intervention were CTC providers and systems in each country. The approach to the intervention and its measurement was made in a manual provided in the supplementary material of Kok et al. (38) and improvement was assessed using both qualitative and quantitative methods. Findings on improving supportive supervision of CTC providers and subsequent impacts on motivation were documented (24,31,39).

3) Following this, the consortium developed and implemented an approach to building local capacity to conduct QI in community health systems with sub-national and community teams. This was termed 'locally-led QI' focused on building capacity for local teams to take over the roles done by researchers in Phase 2. This is in contrast to 'researcher-led QI' described above because local, health system QI teams were given the freedom to identify their own priority problems and solution.

The consortium used a common intervention design and research approach in all sites, although the CTC providers' training, responsibilities and disease foci of their work varied across the countries. The diversity in typologies covers a wide range; for example, health extension workers in Ethiopia are trained for 12 months and salaried to deliver a large curative package of care as formal employees of the health system. Kenyan community health volunteers, on the other hand, receive just a couple weeks of mandatory training and are unpaid, conducting primarily preventive and promotive care, as well as referrals for many maternal and child health conditions. For further description of the community health system and community health worker typologies in each country/implementation site, refer to Appendix 1.

1.3. The QI for community health intervention

The QI capacity development implementation (the third circle in Figure 1.1) is the focus of this study. Its implementation across the 6 REACHOUT countries was guided by a common approach or protocol. The intervention design was led and designed by Drs Victoria Doyle and Miriam Taegtmeyer from the Liverpool School of Tropical Medicine (LSTM) and is the further development of work they have conducted independently and jointly across several countries in South America and Africa. Most directly, the conceptual underpinning for this work was published by them in the WHO Handbook for Improving Human Immunodeficiency (HIV) Testing and Counselling Services (40) and the conceptual framework on p.6 of that document was used to frame assessment of the implementation by the consortium team.

In each country, the common approach to locally-led QI involved three phases of facilitated capacity development interspersed with periods of implementation of the approach by new QI teams. The intervention was delivered between 2015-17 in all REACHOUT countries and continued in Kenya into 2019: Phase I training involved an introduction to quality for community health and team-led problem identification, root cause analysis, prioritization and solution generation for the priority problem; Phase II training involved a review of data on the QI problem selected and assessment of progress to date, along with modifications of the approach if needed; Phase III training involved a learning and exchange session between the teams/sites within a country. The content of each phase is shown in Figure 1.2, replicated from Otiso et al. (41). Despite contextualisation of the intervention, all sites followed a set of guiding principles (42):

- Alignment with existing Ministry of Health standards, models and tools
- Data collection for data use by CHVs
- Focused, small set of quality indicators so that change can be easily tracked
- Simple, jargon-free training materials in response to CHV feedback
- Clearly defined roles and responsibilities for quality improvement at all levels
- Recognition of good practice and celebrating success
- Incorporation of community voices

Interspersed with the training activities were periods of implementation of the QI approach by teams. This work, supported by project-funded mentors/trainers, was the equivalent of what the QI teams would do on a recurrent basis after the conclusion of the training:

- QI teams at each site met on a regular periodic (monthly/bimonthly/quarterly) basis. These meetings occurred at a regular venue and allowed for regular assessment of progress against QI action plans and modifications as necessary.
- During QI team meetings, teams continuously identified problems and generated solutions or interventions underpinned by QI action plans to address those problems, based on their local criteria for prioritization.
- These locally-defined interventions or action plans were then implemented over time and assessed by the team according to locally-available and identified data sources.
- Based on that assessment by the team of the outcome of their own interventions, the QI approach was repeated on a cyclical basis, either to continue addressing the same quality problem in a different way or to move on to a new priority.

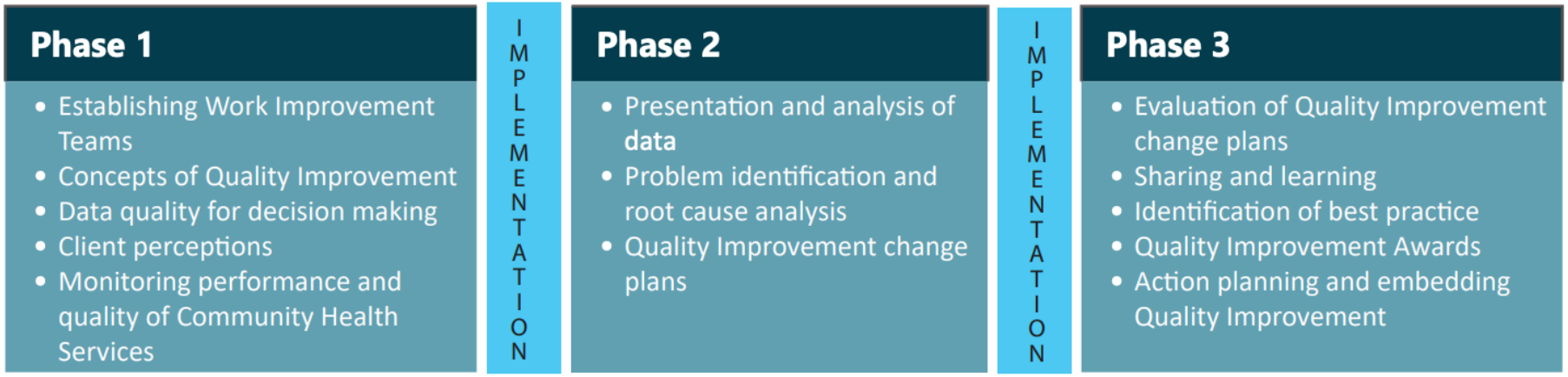


Figure 1.2: Phased approach to community QI capacity development

Further details of the common approach to QI capacity development were published in a policy brief (41). Each study country's implementation team adapted the global curriculum (training materials, slides, and activities) to ensure comprehension by the target trainees (i.e. QI teams) and alignment with their responsibilities for health activities, supervision, and community engagement in each context. In some cases, particularly Kenya, the teams engaged with a wider group of health system stakeholders to better align these materials to existing standards and guidelines for service. Each country's researcher-policymaker implementation team then worked with sub-national health system managers to identify appropriate membership for the QI teams. The major factors that varied between implementation sites were: CTC typology, supervision and QI team membership, and differing approaches to embedding and financing QI. For example, the responsibilities of the CTC providers in a given context led to prioritisation of QI problems in relevant health areas by the QI teams (Table A2.1), leading to different impacts, which is discussed further in Chapter 5. A summary of the contextualisation and description of the relevant factors to the evaluation is presented in Appendix 2.

1.4. Study aims and objectives

The aim of the thesis is to generate and evaluate the economic evidence on whether QI for community health is a 'good investment' for LMIC health systems and consider how that evidence is or could be used in community health decision making at national and international levels. This will be assessed according to the following objectives:

1. To measure the costs and budget impact of QI for community health
2. To estimate the cost-effectiveness of QI for community health
3. To explore the use of evaluation evidence by decision makers who are responsible for financing and setting policy for community health

This study fills both evidence and experience gaps. On the one hand, low- and middle-income (LMIC) governments, and external funders of healthcare in these settings, speak widely of their aspirations for CTC providers to increase access to primary healthcare services and achieve high-quality UHC. In contrast, the current evidence base on large-scale CTC programs shows that quality and access are highly

variable in such programmes both over geography within a country and over time in the same geography. QI, while a promising approach to addressing this variability, has been tested at community level only in limited, controlled settings without generating generalisable economic evidence that could allow decision makers at financing, policy and programme level to assess it against other potential approaches to improve primary healthcare quality and equity.

1.5. My role in the research

I designed this PhD and integrated economic evaluation into the larger consortium research during the third full year of the REACHOUT study, immediately prior to the inception of the locally-led QI interventions in each country described in section 1.5. I joined the REACHOUT consortium team as the research programme manager in mid-2015. From then until the end of the funding period (early 2018), I was responsible for co-designing inter-country research tools, ensuring research data and output quality, overseeing timelines and trouble-shooting implementation by each country team, as well as supporting analysis and dissemination of the results of the consortium's work on both national and international levels through reports, briefs and publications. For a full list of the related publications that I co-authored, please see Appendix 3. The daily requirements of this post involved support to country implementation research teams (both in person and remotely), which allowed me to develop a close understanding of each health system as well as the contextualised approach to implementation and fidelity to intervention design. Being based in Nairobi full time since the end of 2011, and throughout the duration of my thesis, has given me a particularly close understanding of the Kenyan context.

A description of the elements of the consortium that overlapped with my study is shown in Figure 1.3. My role as the principal investigator of the economic evaluation was to clearly delineate the aims, scope and methods for that work, as briefly described in section 1.4 and elaborated in section 3.1.

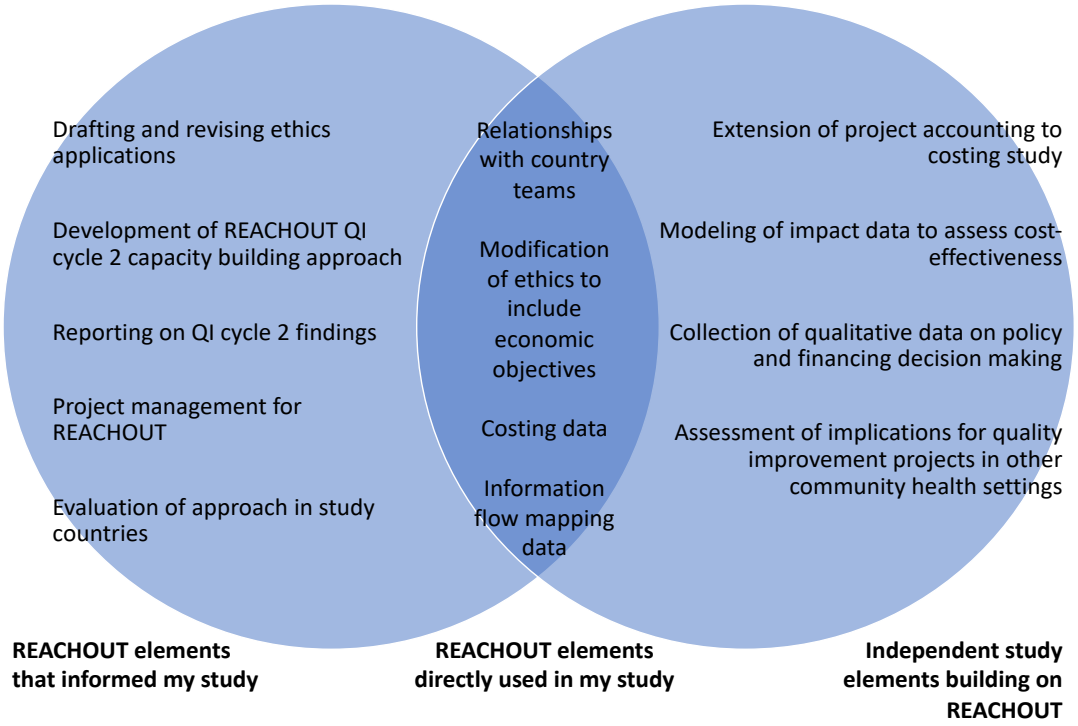


Figure 1.3: Relationship of PhD relative to REACHOUT investigations

1.6. Structure of the thesis

The thesis is presented in seven chapters, including this one. In Chapter 2, I present the findings of the inter-disciplinary scoping review I conducted. In Chapter 3, I give a detailed description of the study sites selected, and the research methods. Chapters 4-6 form the body of the results and are presented in a mixed-methods approach to answering the overall research aim. Each chapter is presented in the form of a peer-reviewed publication. These are linked using an introductory section preceding each paper that shows how they build on each other and link together. Specifically, I present:

- In Chapter 4, the costs and affordability of QI for community health, addressing Objective 1, as published in BMJ Global Health (43);
- In Chapter 5, a case study of antenatal care in Kenya to model the impact of the QI intervention on key health outcomes (including infant mortality, low birthweight, mother-to-child transmission of HIV and congenital syphilis) and estimate the cost-effectiveness of QI for community health, addressing Objective 2, presented as revised following reviewers' comments from Health Policy and Planning;

- In Chapter 6, the perspectives of various decision makers (including funders, policymakers, researchers, and health system managers from global, national and sub-national levels of multiple intervention countries) on the use of evidence in CTC healthcare and its role in decision making, addressing Objective 3, presented as submitted to BMJ Global Health.

In the final chapter, I bring together the content of the three papers, discussing the links between the themes of the three publications and I examine what the publications have added to the existing literature presented in Chapter 2. Lastly, I explore the implications of these results for policy, financing and research: in scaling up community health worker programs, in ensuring high-quality care as a key component of the push to UHC for LMICs, and more widely in how to navigate complexity to allow evidence to better inform policy and practice in these settings.

2. Literature Review

2.1. Introduction

This Chapter aims to introduce the theoretical concepts and key debates on the thematic areas underpinning the thesis to assess the gaps in the evidence and justify the need for this thesis. Specifically, it has the following objectives:

1. To review and assess what is known about quality of care and how it can be measured in community health systems
2. To examine what is known about challenges and approaches to economic evaluation in community health systems
3. To examine contextual influences on and describe how QI has been implemented and evaluated in community health systems in LMICs
4. To identify empirical cases of QI in community health systems and assess methods used to evaluate their implementation
5. To critically appraise processes of decision making in community health systems and how this might affect decisions to finance QI

Although this thesis has economic evaluation as its primary lens, there are elements of systems thinking, complexity theory, evaluation and quality management that underpin the questioning – and I explore aspects of this here, in an interdisciplinary non-systematic scoping review of the literature bound by the aims and objectives described above.

The sections that followed build logically on each other. In an ideal context, the quality of CTC health care (Section 2.3) relies on clearly defined standards of service delivery and reporting that (if met) can be linked to health outcomes. Costs can then be linked to these outcomes in an economic evaluation (Section 2.4). Quality gaps addressed through simple quality improvement approaches are likely to have significant benefit at low cost in helping CTC provider to achieve the defined standards (Section 2.5). Finally, economic evaluations build investment cases that guide logical evidence-based decision making responsive to local context and need (Section 2.6).

In each of the four key themes I present complexity as a cross-cutting issue and interrogate relevant theories on complexity and the importance of political economy.

I also ground the presentation of complexity in a conceptual framework from Brown and Lilford examining how to evaluate complex service delivery interventions that I us to underpin the approach in my thesis of understanding what is context and what is fidelity to the intervention. The literature review thus presents what is already known and what the gaps are, presenting the rationale and justification for the research (see section 2.7.1) The literature and concepts in this chapter will be revisited in Chapter 7, where I place the contribution of my findings in the context of what was already known and opportunities for further research.

2.2. Methodology for literature review

2.2.1. Search strategies

The following databases were searched: Embase, Medline, Econlit, the National Health Service Economic Evaluation Database, UK National Health Service Health Technology Assessments, and the Cochrane Library. For all searches, the following keywords were used for community-level care: ["community health" or close-to-community or "lay health worker"]. Where required, the following terms for economic evaluation were used: ["economic evaluation" or "cost-effectiveness" or "cost-utility" or "value for money"]. Where required, the following terms for QI were used: ["quality improvement" or QI or "Plan-Do-Study-Act" or "PDSA cycle" or "improvement cycles"]. To identify cases of community QI implementation presented in section 2.5.1, I applied the following inclusion criteria:

- QI teams included local staff (QI problems not defined or selected by external project/research staff only) and community representation
- Explicit inclusion of QI cycles in the study description
- An evaluation of the QI intervention was conducted

Keywords were identified by examining relevant references in the literature, previous related literature reviews, and the medical subject headings (MeSH) used by Embase and Medline. In addition, references from suitable papers were used to snowball and identify other key literature, including further peer-reviewed studies; reports from World Health Organisation, The World Bank and grey literature. Searches were limited to full length references published in the English

language (to enable in-depth reviews to be carried out), references published from 1990 onwards (to ensure that the results were applicable to the present setting) and studies in humans. The literature searches were undertaken in May – August 2017 and updated in May – June 2018. References that met the inclusion criteria were read by the author, who extracted relevant material. These searches were not exhaustive; I present a scoping review rather than a systematic review.

2.3. Quality of CTC healthcare: the evidence

Quality of healthcare is typically measured across two broad areas: clinical or technical quality, sometimes measured by approaches like checklists for guideline adherence and clinical audits, and perceived quality, measured through patient reports and environmental assessments. In 2018, three major reports focused on quality in healthcare came out, building the global consensus that coverage or access alone is insufficient to achieve national and global goals for health (44–46). However, these publications missed the opportunity to include aspects of community health in their recommendations and frameworks (47).

There is extensive evidence that CTC providers can deliver quality healthcare, both on a project basis and through systematic reviews (48,49,58,59,50–57). This is found in reviews of CHW programs and their performance as well as in reviews of reviews. However, in many cases these results do not generalise to larger-scale implementation at community level.

2.3.1. Dimensions of quality

Defining and measuring quality of healthcare has its own body of literature, recently summarised by Fatima et al. in the International Journal for Quality in Health Care (60). Quality measurement at any level can incorporate inputs (workforce, supplies), processes (clinical activities, supervision), as well as outputs (coverage, referral) and outcomes (mainly health-related) and can be measured from the perspective of supervisors/employers or service users, as defined for community health systems by our team of co-authors in a recent conceptual framework (61). I regard the key

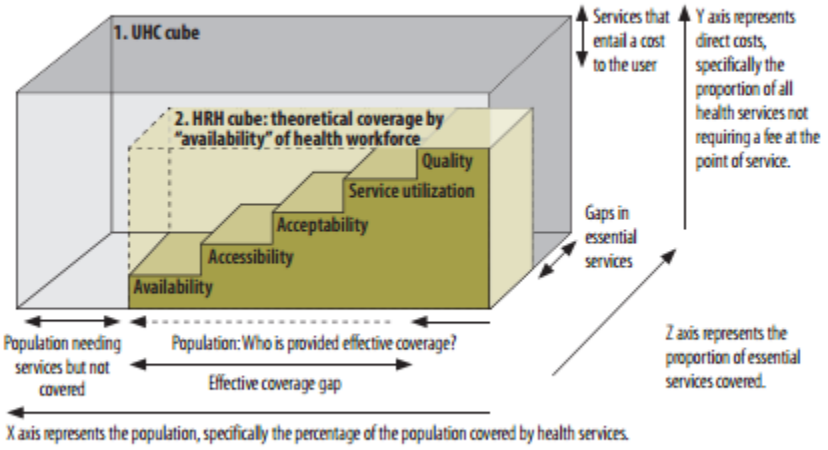
dimensions of quality at community level as being: 1) coverage (increasing the number covered by services); 2) competence/performance (knowledge and delivery of a high-quality service); and 3) client/patient satisfaction, each described in a paragraph below.

Coverage

For community level health systems, pushing to be recognised as a sub-system of the healthcare system (62), the aims of expansion have historically involved expanding access to primary care services. There are barriers to access that are conceived of by Thiede et al. as availability (includes geographical access, the historical focus of CHWs on populations more than five kilometres from a primary care facility in rural areas), affordability (financial protection), and acceptability (cultural appropriateness, e.g.) (63). Levesque and colleagues broaden the definition of access by adding an additional two dimensions focusing on patient-centredness: approachability and appropriateness (64). By extending the dimensions of accessibility and describing the corresponding abilities required of a population to achieve access, they surface some outstanding questions about equity in coverage. Meanwhile, the UHC agenda does not explicitly consider access or even quality *ex ante*, although the inclusion of 'effective coverage' on top of the UHC cube by Campell et al. (reproduced in Figure 2.1) was a welcome addition to the literature that addressed the dimensions of access (65).

Figure 2.1: Defining effective coverage

Fig. 1. **Dimensions of universal health coverage (UHC) pertaining to human resources for health (HRH): effective coverage**



Adapted from *The world health report* (2010),[4] UN Economic and Social Council (2000)[22] and Tanahashi (1978).[19]

Competence/performance

Most of the evidence on quality at CTC level focuses on the technical or clinical definition of quality, where improving health indicators are the main outcomes of interest and the adherence to protocols, guidelines or decision algorithms is the gold standard for care; this is often described as performance. These outcomes may be measured periodically through large-scale population or household surveys (to obtain prevalence and incidence data, e.g. Demographic and Health Survey). Routine data from community level tends to focus on activities, and combined with data from health facilities in areas where CTC programs are active can give an indication of quality through trends in the number of cases observed of various diseases and conditions (e.g. paediatric pneumonia, diarrhoea, malaria; cholera; home deliveries in pregnancy). Other teams have taken a modelling approach to predict the impact of CTC coverage on health (66), again with the potential to include equity in the distribution of the impact. However, attribution of any effect to CTC work is challenging due to the lack of defined standards for CTC providers and the care they provide (to whom, what care, how often). Where standards do exist, e.g. Kenya (67), they are unrealistic, not accompanied by standard operating procedures, and/or not well disseminated – either in training to CTC providers themselves, or to supervisors and other health workers.

Client/patient satisfaction

Though there is limited evidence around coverage and performance aspects of community healthcare quality, there are yet greater gaps in the evidence around perceived quality. This is in part because, to an even greater degree than a clinic-based consultation, it is difficult to measure an encounter like a home visit that cannot be easily observed without influencing the conditions. There are valid tools for patient experience measurement and patient-reported outcomes focused on antenatal care (ANC), for example as described in Al-Shammari et al.'s recent publication from Kenya (68). Here they describe collecting these data using mobile technology on both outcomes and satisfaction with care received. A recent study of home-based or community delivery of antiretroviral drugs by Geldsetzer in Tanzania

focuses on improved satisfaction, timeliness and confidentiality (accidental disclosure), but limits assessment of satisfaction to a single Likert scale question. The systematic capture of satisfaction data does not form a part of routine CTC programme monitoring or evaluation in any country at the time of this review, though community-based care may give an opportunity to provide more client-centred, responsive services addressing gender, power, and social norms. Finally, although demand-side or patient experience aspects of quality should be intrinsically valuable to a healthcare system as part of person-centred care, there has been little effort to use this as a metric for performance review or opportunity for improvement in supervision. Differentiating between patient satisfaction and patient-reported outcomes is an important first step to validating and using such measures more routinely (69).

2.3.2. Quality measurement at CTC level

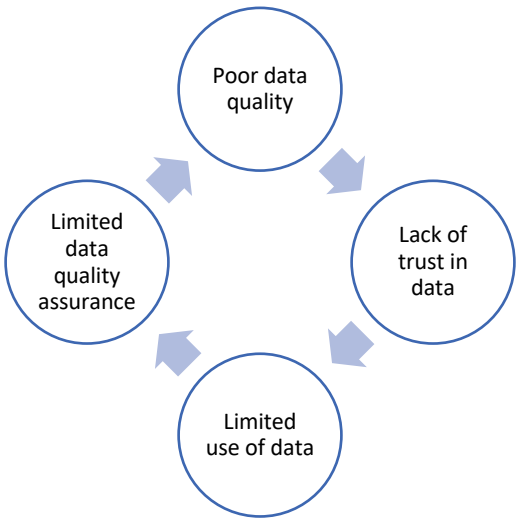
Users, providers and/or regulators need to be able to measure any valued dimension of quality in order to improve it (70,71). However, in most cases any data collected in routine CTC registers focus on the input and process components of technical quality, e.g. Kenya's household register contains tickbox measures for items including "child participated in growth monitoring" and "mother counselled on exclusive breastfeeding". Few are quality indicators. Of those indicators that are reported, the data are aggregated and input either by direct supervisors of the CTC provider, often primary facility staff, or even farther above the community levels in the reporting hierarchy, for example by district staff who have not directly interacted with the providers collecting the data. Measurement (or not) of activities and outcomes from CTC level have a direct impact on the ability of the system to evaluate interventions and accurately assess their benefits beyond simply assessing whether numbers increased. The poor quality of routine data and the possible systematic impact on over- or under-reporting was showcased in the Kenyan and Malawian settings in a recent publication, suggesting that a precursor to assessing QI using routine data is improving routine data quality (72).

The MEASURE evaluation framework on data quality (73) sets out seven major dimensions of data quality; the literature on data quality from CTC level emphasizes

the following dimensions: completeness, timeliness and accuracy. A study in 2013 in one district of Malawi found poor community data quality in 80% of study sites in the baseline survey; a 2016 study builds on those findings showing that despite a reasonable system for monitoring and evaluation, the inconsistencies in data quality for integrated community case management were often introduced between levels of the health system (74,75). In a three-country study in sub-Saharan Africa, findings between settings were inconsistent, illustrating the potential of community health worker data to be of high quality while highlighting outstanding questions about maintaining data quality at scale under routine supervision practices instead of project-supported rigorous data quality checks (76).

Because of concerns about data quality and reliability, community data are rarely trusted and thus rarely used (72). This presents a potential problem at various levels of the system – supervisors are not able to give feedback on service quality and appropriateness, and higher-level facility and policy decision makers do not use the data to inform their resource allocation decisions. The lack of data use results in vicious cycle of intrinsic de-valuing of the data shown in Figure 2.2: the data are not trusted and are therefore not used; CTC providers know that data are rarely quality checked and thus they 'cook data' to get monthly stipends or supplies; this further worsens the quality of the data and so forth. This is a potential immediate opportunity for improving data quality through data use, e.g. in supervision visits, as shown by REACHOUT in a 2018 paper focused on four sub-Saharan African contexts (38). Though this study focused primarily on the relationship between supervision and motivation, it highlighted the central role of data quality and feedback in motivating CTC providers.

Figure 2.2: Vicious cycle of poor data quality and limited data use



2.4. Economic evaluation of CTC health services

Economic evaluations of community health services have overwhelmingly shown cost-effectiveness, though to varying degrees in various settings; a review of economic evaluations of CTC programs focused on those to improve child health outcomes was undertaken by Nkonki et al., who found that all interventions studied were either cost-effective or highly cost-effective by applying the WHO Commission on Macroeconomics and WHO-CHOICE thresholds (77). Other studies have also applied these thresholds to argue for cost-effectiveness of CTC providers' work (78,79), though these are no longer in general use and a nuanced discussion of options for cost-effectiveness thresholds is still ongoing in the literature. Even in settings with very low gross domestic product per capita, like the Gambia, community-based interventions have been shown to be cost-effective (80). Yet many of these economic evaluations of CTC interventions have significant methodological challenges including: complexity of costing and perspective, attribution of outcomes, variability in typologies across contexts.

Economic evaluation data in theory provides information about the costs of an intervention compared to the outcomes it yields, providing a means to compare different investments. If routine data quality allowed, referrals from CTC could be tracked to observe increased uptake in curative services to improve health outcomes. Using CTC providers to extend access toward the global goal of UHC has become politically popular (81,82) as described in section 2.3 above, yet poor data quality, as described in section 2.3.2, affects measurement across both costs and outcomes. This makes evaluations based on routine data insufficient to underpin investment decisions. Although non-routine research evidence shows that well-resourced CTC providers can provide high-quality care, this is primarily derived from short-term, project-based analyses rather than the evaluation of long-term, locally-owned interventions (59,83), potentially not reflecting real world implementation scenarios. The limited non-routine quality assessments that have been conducted on larger-scale CTC programs do not unreservedly support the political push for scale (84).

As with any service delivery platform, increasing health service access and providing care at community level will require trade-offs with other health investments or an increased budget, either of which imply an opportunity cost. Yet policymakers often lack locally-relevant evidence, with economic evaluations from health care in LMICs in particularly short supply. Where it exists, this economic evidence often focuses on cost-effectiveness thresholds (85) and neglects affordability and budget impact, all of which are key to evidence-based resource allocation. Economic evaluations that address issues of affordability in real-world settings are needed to underpin these investment decisions in various contexts (77,86).

2.4.1. Complexity in costing

Costing community health services is challenging in part due to a reliance on part-time and/or volunteer workers who incur time and sometimes financial costs, as they may pay out-of-pocket costs for food or transport to support the effectiveness of the programmes (78). These are not always included in economic evaluations taking a health system perspective, and may be deemed prohibitively expensive to collect. Some efforts have been made to overcome these using modelling approaches to estimate dedicated provider time and activity mix (78,87,88), to account for the fact that volunteer workers may choose to spend their time on other activities. Not taking a societal perspective limits the assessment of the full cost of programmes, and the burden of the additional costs lies predominantly on more vulnerable CTC workers and their patients. Because they perceive CTC care as 'free' to the system, potential users of these economic evaluations may not consider this evidence necessary, limiting commissioning at local and national levels.

2.4.2. Complexity in outcome assessment

A second methodological challenge to economic evaluation at CTC level in LMICs is in assessing the outcomes of this work. Current investment in CTC programs continues to focus on increasing coverage, counting numbers of people accessing services instead of quality (44,81,89). This has the additional advantage of being easy to measure. Therefore, regular monitoring of quality of care in CTC programs is limited, yielding high uncertainty around the outcomes component of economic evaluation ratios. Additionally, there are significant challenges to measurement and

attribution of the long-term benefits of primarily preventive and promotive services provided by CTC health workers, part of an ongoing debate in the literature on how to evaluate complex service delivery interventions (90–92). Because of the long causal pathways between many CTC activities (e.g. referral) and health outcomes, achievement of outcomes from these services are mediated by service availability and quality at primary healthcare facilities.

Contextual variability

Finally, economic evaluations are often developed with a specific decision problem in mind – for example, whether to invest in a new point-of-care test for anaemia to be used in ANC. Researchers, author not excepted, often attempt to generalise such findings to wider regional implications or even LMICs generally. However, the wide variability in the training, responsibilities and support to CTC providers across contexts (Appendices 1 and 8) raises questions about generalisability of findings (11). Decision makers or potential evidence users face challenges assessing the relevance of community health evidence to their settings.

2.4.3. Inclusion of affordability in economic evaluation

Affordability is the comparison of the cost of a potential investment against the budget available to pay for it. This is often done through a budget impact analysis, which is part of the recommended constraints to be included in the reference case for economic evaluations by the international Decision Support Initiative (93). However, in a recent assessment by Emerson et al. over adherence to the reference case in published studies over six year, just 9-10% included budget impact analysis (94).

Lack of affordability assessment is a major limitation to the usability of economic evidence: often, economic evaluations evaluate cost-effectiveness against a threshold derived from societal preferences on different life states and willingness-to-pay, where available, or more general decision rules, the latter particularly in LMICs by WHO-CHOICE and more recently by other authors critiquing this threshold (95–98). That is, they compare two approaches (often, current practice to a new practice for any aspect of care, including treatment, prevention, screening) and

assess incremental costs and outcomes incurred by the same cohort of patients under each approach (99). In 2009, Shillcutt et al. examined different methodological approaches to estimating relevant values of the threshold for various LMICs (100). Building on that work, an examination of cost-effectiveness studies on vaccines in LMICs describe cost-effective interventions subsequently not being implemented, presumably due to budget constraints (101). In all settings and particularly resource-limited LMICs, simply assessing an intervention as 'cost-effective' in relationship to a threshold or ceiling ratio does not mean that intervention can be (or should be) invested in within current constraints.

2.4.4. Investment cases for community health

Over the last five or so years, investment cases have been promoted as an economic advocacy tool to both increase allocations within countries to (preventive) health from Ministries of Finance and of fundraising globally, all toward the aim of increasing sustainable financing for community health. An investment case is a cost-benefit analysis intended for advocacy, a form of economic evaluation that usually focuses on estimating the benefits of an intervention in financial terms, focusing on economic return on investment. The first of these to rise to high visibility was global community health worker investment case, presented in 2015 by a panel convened by Prime Minister Hailemariam Dessalegn of Ethiopia and Ray Chambers, the United Nations Secretary General's Special Envoy for Financing the Health MDGs and for Malaria (102). This study cited a return on investment of 10:1 but cautioned a need for active performance management and contextualisation to reap these benefits.

Building on this success, the Global Financing Facility issued a guidance note on investment cases, noting benefits of this approach such as better prioritisation, explicit returns on investment, and reduced fragmentation (103). Following on from that, an investment case for community health in Kenya found favourable returns on investment of 9.4 times (104), and both the Financing Alliance for Health and Management Sciences for Health have supported countries in costing and building investment cases, though these are not all in the public domain (105,106). These are not usually presented in peer-reviewed journals but rather as working models and in reports and white papers, limiting opportunities to critique the methods and data

underpinning them – yet they form an important and growing part of the health economics grey literature on CTC healthcare. Unfortunately, the evidence suggests that this approach may not be as convincing as expected; a recent paper in the WHO Bulletin describes decreasing financing for community health decreasing despite the proliferation of investment cases (107).

2.5. Quality improvement in community health

In the initial sections of this chapter I have described the level of quality that is possible at community level with clearly defined standards and approaches to economic evaluation at that level of the healthcare system. However, I have set out some of the 'quality gaps' to achieving high-quality community healthcare at scale. The intervention evaluated in this thesis, locally-led QI for community health systems (section 1.4), is one possible approach to overcoming the obstacles to quality at scale in community healthcare.

QI is a discipline-agnostic management process that involves identifying problems or opportunities for improvement in a system, selecting a priority from among those, testing a means of solving that problem and evaluating whether that solution is effective and sufficient. It relies on localised data collection, data analysis and data use for problem solving relevant to the setting. This repeats in a cyclical process indefinitely, so it is sometimes known as continuous QI; see Figure 2.2 for a schematic adapted from Massoud et al. (108). QI can serve as a means both of improving understanding of current quality in priority areas (through improvements in measurement of priority problems and data quality) as well as improving the quality of services delivered, once measurement data are reliable.

In LMICs (much as in high-income countries), applications of QI in healthcare have been generally applied to facility-based healthcare and especially to higher-level hospitals that have ample financial and human resources. In theory, QI can be done in any context and within available resource envelopes (e.g. changes in provider attitude do not have a financial cost). In practice, only some of the problems identified will likely be resolved without additional investment. Outcomes or impact of QI is likely to be dependent on the level of investment made. By involving meso and macro levels (e.g. supervisory or catchment and district), QI can become a synergistic effort that may provide additional return on investment but is likely to come at a cost.

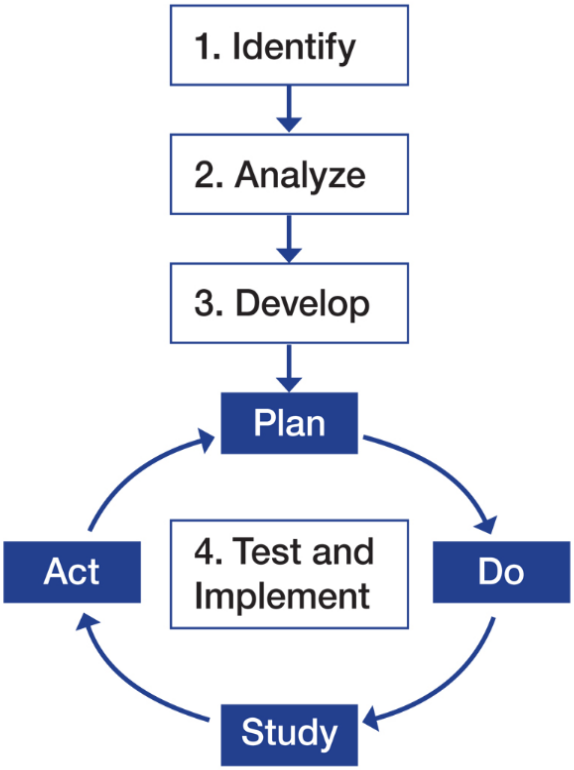


Figure 2.3: The Plan-Do-Study-Act quality improvement cycle

Large projects have taken QI to LMICs but stopped short of community health. The most widely publicised example of large-scale QI in LMICS is the USAID- Applying Science to Strengthen and Improve Systems (also known as the ASSIST) project that worked across 38 countries; another is the African Health Initiative working in five sub-Saharan countries (109,110). Each of these takes the first step of recognising the role of communities and frontline workers in achieving improvements in outcomes of interest (e.g. through improving community-facility linkages and referral, creating demand for services) and the potential of delivering interventions at community level, but they do not include community-level health workers or community members in the QI capacity building and ongoing activities.

2.5.1. Evaluation of QI at the community level in LMIC settings

The review of the literature on community QI revealed only ten relevant site examples or cases of the application of QI approaches in community health in LMICs published since 1990 (Table 2.1).

These studies give a broad representation of the types of interventions that have been tried at community level; in all cases they address maternal or child health as the broad health area of priority, in keeping with the local responsibilities of the CTC providers. Similarly, economic aspects in these community QI evaluations were glaringly absent in the studies summarised here – none considered costs of the intervention (only one considered costs to the patients), though many described their intervention as 'low-cost', primarily in background sections of the publications. Where outcomes were considered, in several cases these were QI capacity-related, examining the feasibility of QI at community level and focused on the process of the QI approach (16,18,111–113). The four programmes that included health activities and health outcomes had a much heavier facility-based component, often with facility-led and focused teams that included community representation and change plan activities (114–119). Economic evaluation of QI as a health systems strengthening intervention at community level (as opposed to improving quality of specific community health services as part of a project intervention) is non-existent according to the outcomes of this literature search.

Table 2.1: Summary of quality improvement studies in community health systems

Location (reference)	Health area	QI team members	Costs evaluated? (Methodology)	Outcomes evaluated (methodology)	Relevant findings
South Africa, Malawi, Mozambique (18)	HIV	CHWs (some health workers such as outreach nurses, supervisors, local leaders)	No	Training-related outcomes e.g. knowledge of QI concepts/ no health outcomes (case study)	Simplicity and mentorship are essential
South Africa (114)	Maternal health; HIV	CHWs and supervisors	Transport to the clinic (Interviews with mothers)	Home visit rates for pregnant women, maternal knowledge, exclusive breastfeeding; disclosure of HIV status (Interviews with mothers)	QI mentorship is an effective alternative/additional form of supervision at CTC level
Tanzania and Uganda (16,111,112)	Maternal and newborn health	Village volunteers	No	Training-related outcomes e.g. knowledge of QI concepts (case study; process evaluation; realist evaluation; plausibility study)	Plausibility evaluation focused on multi-level intervention, not only the community component
Ghana (115,117,120)	Child health	Facility teams (sometimes with community representation)	No	Early ANC, 4+ ANC, skilled delivery (Facility registers)	Implementing change plans in the community but not clear if community-driven

Location (reference)	Health area	QI team members	Costs evaluated? (Methodology)	Outcomes evaluated (methodology)	Relevant findings
Ethiopia and Tanzania (119)	Maternal health, HIV	CTC providers, existing community networks, and facility staff	No	ANC registration, household visit rates, HIV testing rates (case study; situation analysis; qualitative interviews)	Community team members lent credibility to CTC providers – related to trust issues
Ethiopia (113,118)	Maternal and newborn health	Village council members, priests, agricultural association and women's association leaders, health extension workers, community health development agents, and traditional birth attendants	No	Training-related outcomes e.g. knowledge of QI concepts (survey and qualitative interviews) Coverage of maternal and newborn healthcare; perinatal outcomes (surveys and verbal autopsy)	Multi-level intervention involving community, facility and district (woreda)

2.5.2. Methods for economic evaluation of community QI

Reflecting on the absence of economic evaluations for community QI, it became clear that methods for economic evaluations of health systems strengthening (HSS) interventions in general were limited. In a 2018 paper, authors describe three types of HSS interventions amenable to economic evaluation: efficiency improvements, relaxing capacity constraints, and new shared platforms (121). While this is an important next step for modelling these impacts, examples of primary data collected on this are few.

There are more methodological options if one broadens understanding of QI to be defined as a complex service delivery intervention; original recommendations on this type of evaluation were presented by the United Kingdom's Medical Research Council (122,123). In Figure 2.3 below, I replicate the framework from Brown and Lilford (2008) that conceptualises of evaluation of complex service delivery intervention at different levels of the system, expanded from Donabedian's work on structure, process and outcome (90,124). This shaped my thinking on developing the methods for the evaluation on two fronts: one, what should be considered 'context' and may support understanding of how the intervention worked and what influenced it; and two, what are the proximal outcomes for evaluation of our QI intervention. The authors state that at whatever point the intervention occurs, everything to the left in the framework can be considered contextual and the immediate right is the most proximal point at which to measure the effectiveness (or outcome) of the intervention.

The introduction of QI into the community health system, the service delivery intervention evaluated in this thesis, would constitute a change at the management process level of the system as per this framework. This suggests that when developing methods for evaluating the outcomes of this intervention, assessment of the performance CTC providers would be a key intermediate variable or proximal outcome variable in the causal chain, mediating impact on the public health or individual patient outcome measures assessed in economic evaluations. I come back to this conceptual framework and its applicability to my findings in section 7.3.

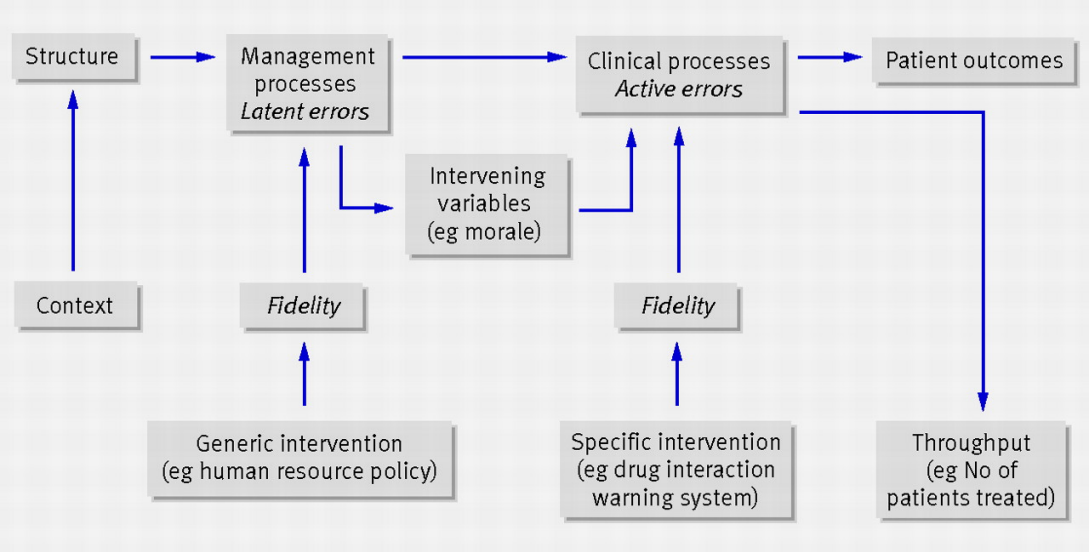


Figure 2.3: Conceptual framework linking interventions to outcomes

2.6. Priority setting and funding decisions for community QI

Following on from the assessment of economic evidence availability for community QI, I consider the use of that evidence in priority setting and decision making. These are both evidence-driven and politically-motivated processes. Even if better economic evidence were available, there would still be a question of whether QI is a good investment – and whether being a 'good investment' is enough to drive decisions. The answer is likely to vary for different contexts and perspectives.

2.6.1. Evidence users in community health

In most evaluations, understanding the perspective of the evidence user is key to defining the outcomes and perspective that would provide the most useful evidence (125,126). In the CTC space, there are multiple levels of evidence users or decision makers that are operating in this complex space, as described by Schneider et al. in their argument for consideration of community level as its own system (62). Evidence users include donors (global), Ministries of Health and Finance (national), health management teams (sub-national), and facility managers. Any individual or team who might make a policy or funding decision could also be a prospective evidence user. If I take a worked example that considers a QI team working on improving early ANC initiation, a community-level team might focus on identifying early pregnancy in routine household visits, a facility-level team might provide community outreaches on ANC services, and a county-level team might consider

changing policy to provide pregnancy tests to CHWs. Each potential decision maker or 'evidence user' in this worked example, at the centre of the structuring of the problem (127,128), might be evaluate success related to the same QI problem using different costs and different outcomes, as well as a different perspective. For example, a community team might focus on a societal perspective including out-of-pocket expenses, the facility-level team might include economic person-time costs of supervision in a health system perspective, while a county-level team might ignore the additional time-costs to the existing human resources and focus on a financial costing of commodities and transportation. Each of these perspectives may be valid and could results in varying investment decisions.

2.6.2. Priority setting processes in community health

As described above with evidence users, priority setting also operates at a multiplicity of levels in health systems and each level may have formal or informal (and often political) processes that underpin these decisions. Priority setting arises as a result of living in a world of limited resources; this is also the rationale underpinning economic evaluation, a tool that is often employed in priority setting processes. However, systems and decision makers may derive processes based on different values, including effectiveness, equity, efficiency, justice, democracy, or others (129).

In the broader health system at higher levels, a framework for evaluating priority setting is described by Barasa and colleagues, including two type of requirements: procedural and consequential, all in the context of community values (130). This builds on the preceding literature on priority setting by acknowledging the importance of outcomes to be evaluated discretely from processes and not simply as consequences of those processes. For example, equity is a normative value in priority setting but was not empirically evaluated in the outcomes of the studies assessed (130). The argument is strengthened by Hofmann, who argues that poor outcomes despite good processes are likely attributable to a range of biases operating across levels of the health system (131). As described by Cromwell et al. in a systematic review on priority setting, "Health care delivery must be guided by the available biomedical evidence, but as it is still a human endeavour, political realities must be

considered and weighed" (132). The more evidence users there are in a space, the more potential for politics to play a role in decision making.

If the priority setting processes are well-designed and fair, they should include a requirement for using evidence to make choices – both choices to add or invest in additional interventions or to disinvest from those that are not meeting criteria. The role of economic evaluation in the community health decision space is little explored in the literature. A recent review by Wiseman et al. examined frameworks for inclusion of economic evidence in setting health care priorities in LMICs, finding that most studies used measures of efficiency, most commonly cost-effectiveness and/or multi-criteria decision analysis (133). Despite severe constraints on resourcing, only a third of papers considered affordability and only one addressed disinvestment.

2.6.3. Relevant aspects of context to decision space

Context also plays an important role in the priority setting and evidence use for community health, through aspects including geography, epidemiology, health system structures, and socio-economic status of an area. Using the micro-meso-macro framework suggested by Caldwell and Mays is a useful way of conceiving of and grouping the different aspects of context (134).

The most studied aspect of context, operating at the meso and macro levels of health systems, is the decentralisation of decision making and budget control. Built in part on theoretical contributions from Bossert et al., this has been studied in countries at various stages of implementation of a decentralised health care system (135–137). Abimbola et al. present contextual factors influencing mechanisms of impact in decentralising health systems using three concepts of impact: voting with feet, close to the ground, and watching the watchers (138). In Kenya, McCollum et al. describe a specific process of devolution in Kenya, the most comprehensive of the four forms of decentralisation. It began with the new Constitution in 2011 and has provided opportunities to improve community participation and equity in community decision making through transfer of administrative, political and fiscal functions from the national to the sub-national (county) levels, but was not well underpinned by required capacity development for mid-level managers (139,140). They then work with additional authors to compare the Kenyan experience with that of Indonesia,

showing similar experiences and highlighting the potential role of the CHWs in engendering true community participation in the priority setting processes (141).

Coming back to the multi-level framing of health systems, Kok et al have looked at the implications of context on community health performance at the micro level in a systematic review, describing a gap in well-described contextualisation of community health research (142). The roles and responsibilities of a CTC cadre in relation to QI will be critical in understanding the relevance of QI to the particular context and the types of problems that community teams might handle. In truth, a community QI team might be considered the lowest level of formal priority setting in the health system, as they make value-based decisions on where to allocate resources based on pre-agreed criteria and evaluate themselves according to a consequentialist framework, i.e. by assessing the impact or outcomes of their change plans after implementation (130).

2.7. Generating economic evidence on QI in community health systems

In summary, the evidence shows that CTC providers have the capacity to provide high-quality, cost-effective care under certain conditions. However, the quality of care provided is not consistently high across evaluations, influenced by various aspects of context, supervision and motivation. This is a limitation in many economic evaluations, often modelling approaches conducted on project-based implementation and outcome data that does not reflect real world constraints on quality. QI is a structured approach to measuring and improving quality that can be effectively implemented at community level to support the CTC healthcare provision. The evidence for this, although drawn from small sample case studies in relatively few settings, comes from several cadres and health areas. Yet QI is not a stated or implicit priority in most LMIC health systems despite the opportunity to better leverage existing resources.

2.7.1. The Knowledge gap: utility of this thesis

The review of the available literature shows two significant gaps. Firstly, there is an absence of economic evaluation for QI in community health systems. In the limited number of cases evaluating QI for community health found in the literature (Table

2.1), economic evaluation was not used. Now that feasibility of implementing QI at community level has been shown in multiple contexts and focused on different health areas, there is a need for evidence on costs, affordability, and cost-effectiveness to inform decisions on whether to invest in similar health system interventions. As the world looks for guidance on how to better design, support, and strengthen health systems that work for all of the population, economic evaluation of multi-country studies on QI implemented in real-world community settings are needed.

The second evidence gap is a lack of information on how economic and other evidence is used in community health decision making. Priority setting is shown to be both a political and evidence-driven process in community health, as in almost every area. Yet what is not known is what are the levers – how can we as researchers improve the evidence generated to allow it to speak more directly to decision makers' needs? A deeper understanding of the categories of the decision makers, their needs and evidence priorities, the barriers to evidence use and opportunities to strengthen an evidence-based approach would be valuable additions to the evidence base.

In this thesis, I present an economic evaluation of the REACHOUT QI for community health intervention, the first of its kind. This is important for several reasons:

1. Good interventions, like QI, may produce impact or be highly successful in a project setting but still be unaffordable and/or unfeasible to implement in the context of a public health system. Without economic evidence, decision makers have challenges in deciding what project-led interventions to adopt and why.
2. Benefits obtained from community health services and complex health systems strengthening interventions like QI may not directly yield measurable individual or population health benefits. This leads to the systematic undervaluing of such services by healthcare systems and underinvestment in them relative to their potential impact. Similarly, medically-trained decision makers may be inclined to invest in clinical rather than behavioural, community-based, or preventive interventions.
3. Decision makers need to consider quality as part of their UHC strategies, underpinned by evidence that speaks to the role of context so they can

change priorities and make improvements that reflect the values of their communities and that bring value to the communities.

In the coming chapters, I will examine the two sides of the economic evaluation equation, costs and outcomes, as well as looking at the need for and use of economic evaluation evidence. Chapters 4 and 5 present the quantitative findings from the costing and cost-effectiveness studies respectively; in Chapter 6 I examine the qualitative multi-country findings from the key informant study with community health policy and financing decision makers. Each of these chapters has been written as individual articles; as such, there is some overlap between both the background or introduction of each article and also with the methodology presented in section 3.1. Each publication is introduced with a brief description clarifying and linking it to the thesis as a broader work.

I hope the resulting economic evidence on community QI will be of use in selecting and implementing future community health investments that move us toward more equitable, high-quality community healthcare systems in all countries.

3. Methodology

In this chapter, I briefly describe the methodology of each component of my thesis work, presented here as manuscripts. Although some of this may be duplicative of what is presented in the results chapters due to the inclusion of methodology sections in each of the papers, the aim of this Chapter is to provide a cohesive description of the intervention and methodology as a whole in relation to the overall study objectives before presenting the individual sub-studies in the publications (Chapters 4-6). Please note that I refer heavily to the REACHOUT consortium in this section as the intervention that the thesis evaluates was implemented by that group; for further description and any clarifications on how my study and role overlaps with the consortium, as initially addressed in section 1.5.

3.1. Research approach and methodological justification

The study falls broadly under health policy and systems research. With a focus on health economics, the nature of research in complex systems required an interdisciplinary approach. Specifically, the research involved aspects and understanding of public health, political economy, soft systems, innovation, and clinical quality. Together, this mixed methods approach allowed conceptualization of cost, affordability, and cost-effectiveness of the intervention as well as an improved understanding of the utility of such evidence in decision making. The results can give guidance to those financing UHC agendas and exploring how quality, access, and equity are inter-related and might be better accounted for in economic evaluation research and evidence to increase the likelihood of economic evidence-based policymaking.

This thesis aimed to conduct an economic evaluation of QI in community health systems in different countries to provide evidence for investment decisions and to guide future implementation of community health quality and QI programme policy, implementation and financing decision making. In the following sub-sections, I present the research approach and study site rationale used in each study to further this aim. These approaches, which balance desired data-heavy outputs and analyses with pragmatic limitations on health worker time and routine data quality.

The data from the different sections are inter-related and build on each other. In terms of data collection and analysis, I present a timeline of my work in Figure 3.1. I first collected the costing data (first half of 2017) and analysed that data while collecting the qualitative data (late 2017-late 2018); the latter was time-consuming due to the multiple countries involved and ethical approval requirements. Following that, I analysed the qualitative data and then built the cost-effectiveness model in 2019. The cost-effectiveness model directly uses the costing data, so waiting for that to be published before developing the model made sense. The field evidence on improvements related to ANC in Kenya was collected in longitudinal surveys conducted in January 2018/19, so I needed this evidence before starting on this work.

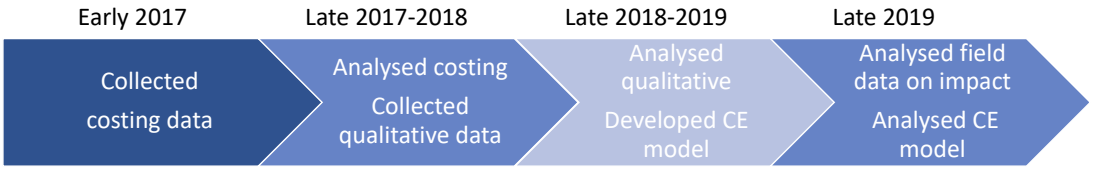


Figure 3.1: Timeline of data collection and analysis

I have chosen to present the results from these papers in a different order than I collected the data. This is in part for the flow of the story; it is evident that costing data can and should underpin a model of cost-effectiveness. The qualitative work on decision making and evidence use could have preceded both quantitative papers or come at the end. I chose to put it at the end because a lot of what I wanted to explore in the discussion was around the decision maker and the complexity of the space. By exploring how current economic evidence (my own possibly included) does not satisfy all decision makers, I make a case for approaches to improving that in future studies.

In the following sub-sections, I give concrete details of the methodology used in each paper, and I present these in the order that the findings are presented in Chapters 4-6. I have provided context and additional detail to what is presented in the papers that follow.

3.1.1. Costing methodology

In Chapter 4, I present the findings of a costing and budget impact analysis of community-level QI in five country settings. I used an ingredients approach to cost the community QI intervention as a project, including researcher costs. This methodology allowed transition from a project-based costing to a model to estimate costs of widespread adoption. The costs of scaling up can be easily estimated based on unit or ingredient costs (though these do not account for economies of scale and scope). I expected to see variations in the results across settings due to both different unit costs or costs of doing business and different approaches to contextualising the intervention. This study was conducted in five of the six consortium countries (except Bangladesh), which includes all implementation sites where the CTC cadre studied was managed by the public sector.

Specifically, this involved designing the tools for primary quantitative data collection on the quantities of inputs and the unit costs of these inputs to be reported by project teams and finance officers in each country, and then computing the cost of each input. Next, I summed the cost of each input to get the total cost for QI (and each component step) in each country, including both financial and economic costs; economic costs are the opportunity costs of forgone alternatives, and includes costing for inputs that do not result in direct financial outlays (such as volunteer time, subsidised inputs etc.) by assigning them their market values in 2017USD. I conducted descriptive analysis of the costs using Excel and took three scenarios to model the costs and budget impact of adoption of the programme into routine practice (base case, active and passive) by public sector staff in each country.

3.1.2. Cost-effectiveness methodology

In Chapter 5, I developed a decision tree model of the cost-effectiveness of community-level QI using an example case of antenatal care (ANC) in Kenya. ANC is a key health area affected by CTC providers. This model combined the primary costing data from the intervention (described in 2.4.1) with measures of impact from the literature. Using these primary and secondary data sources, I present measures of cost-effectiveness of both key policy outcomes as well as disability-adjusted life years (DALYs) against various thresholds from the decision analytic model and

include probabilistic sensitivity analysis around the parameters to assess the robustness of the point estimate.

The freedom of QI teams to choose their priority problem and approach to solving them yielded a wide and unpredictable range of health areas and benefits from any QI cycle across different teams. Instead of taking a true example from the field implemented in a small site (e.g. one community unit) and trying to scale it up across settings, the approach used in the costing study, here I took the health area most consistently covered by CTC providers across settings: maternal health and particularly ANC. Focusing on one country setting allowed me to use primary data from Kenya on population level behaviour change after the intervention, and also helped to provide a clear hierarchy of evidence to underpin the model parameters for outcomes. As I expect the benefits from QI to be yielded across multiple health areas, so this approach likely underestimates the cost-effectiveness.

3.1.3. Qualitative methodology

In Chapter 6, I used qualitative key informant interviews to explore how and when decision makers at national and global levels use evidence in community health decision making. Despite providing economic evidence in Chapters 4 and 5, my perception from prior work with decision makers was that evidence related to community health was not driving their decisions and wanted to understand why, so I could improve my approach to evidence generation and dissemination. In this study targeting key informants at national and global levels involved with community health policy and financing decisions, I explored this topic to understand how and why evidence was used (or not) and what types of evidence might be preferred. I designed the study to be analysed by both different levels and types of respondents as well as by study site or country. This was an exploratory study from which I hoped to derive recommendations for future community health research in this area.

This study is composed of 43 qualitative in-depth interviews with respondents in Ethiopia, Kenya, Malawi, Mozambique and at the global level; I conducted all except four, where the language of the respondent was not a language in which I am fluent. All interviews were recorded (according to consent form), transcribed and coded. Analysis was done according to a framework approach combining deductive and

inductive approaches (Gale et al, 2013; Ritchie & Lewis, 2003). A code frame was developed based on the themes of the discussion guide, with additional nodes added for novel responses and emerging themes. The transcripts were entered in an electronic qualitative data management and analysis software (NVivo) and coded. Data were further analysed: 'charted' in themes and subthemes and summarised in narratives for each theme and subtheme. The narrative led to further questions and associations between the themes to obtain answers to the original objectives and the themes that emerged from the data, the output of which is intended to inform the structure, content and target audience for future presentation of economic evaluation evidence for community health decisions. Quality assurance approaches are presented in Appendix 4.

3.2. Study site selection

Each of the studies presents data from a different sub-set of REACHOUT consortium countries and intervention sites; details of the study sites are presented below in Table 3.1 and Table 4.1. Further general information on the community health systems in these countries are presented in Appendix 1 and details of the typologies of CTC providers found in each is presented in Appendix 8 in the supplementary material to the published costing study.

Of the three studies, the costing study includes the most contexts, covering five REACHOUT countries and all study sites in each country; see Table 4.1 for specific details. This selection was justified by the motivation to identify the affordability and cost-drivers across contexts. Following on from that, the cost-effectiveness study takes the costing data from Kenya (in Nairobi County) and models the effectiveness based on implementation of the intervention (in Migori County) – this country-specific case study could be replicated for other REACHOUT study sites if it were desired by decision makers. However, the Kenyan context was a pragmatic selection for this study as the only context in which primary quantitative data on effectiveness was collected in a representative sampling approach, specifically lot quality assurance sampling of households (143). The qualitative study, Chapter 6, covered the four sub-Saharan African REACHOUT countries, primarily at the national level.

This selection was due to the differences in external financing agencies and approaches in the Asian and African contexts, and the idea that decision making regionally, including political motivations and delays, might be similar across contexts.

Table 3.1: PhD study sites

Study country	REACHOUT implementation sites	Description of the site(s)
Ethiopia	Southern Nations Nationalities and People's Region, Sidama Zone	Rural setting; somewhat marginalised due to distance from national government but strong leadership for zonal level. Sidama is likely to become its own region in near future. High maternal mortality rates and low rates of skilled delivery are priority problems for the health system generally. QI teams were formed at the health centre and woreda levels here.
Indonesia	Cianjur district: Cikalongkulon, Ciranjang, Gekbrong *Pukesmas*	Sub-urban setting; not far from the national capital but mountainous/ highland area. Relatively dense population. *Puskesmas* are sub-district community health centres focused on female health and are staffed by midwives as well as other CTC providers. QI teams were formed at the *puskemas* level here by thematic area; one *puskesmas* had two QI teams.
Kenya	Three sub-counties of each Nairobi and Kitui Counties (2015-2019); added three sub-counties of Migori County (2018-19)	Very different County settings, and health decision making and financing is largely devolved to County level post-2011. Nairobi is the national capital, very urban and lots of informal settlements. Kitui is several hours from Nairobi by car and is primarily a rural and mining County; changes in the community health strategy here have hampered implementation and required retraining. Migori is in western Kenya and has a large fishing community and high rates of HIV prevalence. Free maternal health care was introduced by the Kenyan national government in 2018; the reality of implementation has been mixed. QI teams formed at sub-county and community level here.
Malawi	Mchinji and Salima districts	Rural areas a few hours' drive from the national capital; Malawi is a relatively small country so these are 'remote' by Malawian standards. Decision making still largely national though some discussion around decentralisation ongoing. QI teams were formed at the district level here.

Study country	REACHOUT implementation sites	Description of the site(s)
Mozambique	Manhiça and Moamba districts, Maputo provinces	Both close to the national capital (same province), which gives advantages in terms of visibility and supervision. Transition in district leadership had strong negative impact on implementation in one district. QI teams were formed at the district level here.

3.3. Ethical considerations and approvals

Ethical review was conducted in the first instance by LSTM's institutional review board (IRB) (study 17-009) and this approval was conditional on in-country approval in each of the study countries; for details see Table 3.2 and Appendix 5 for full documentation.

Table 3.2: Ethical approval for data collection in study countries

Study country	Ethical Review Board	Protocol Reference Number
Ethiopia	Southern Nations Nationalities and People's Regional State Health Bureau	ሀጤ 2-8/1754
Indonesia	University of Hasanuddin	597/H4.8.4.5.31/PP36-KOMETIK/2016
Kenya	Kenya Medical Research Institute	KEMRI/RES/7/3/1
Malawi	National Health Sciences Research Committee	1286
Mozambique	University of Eduardo Mondlane, Faculty of Medicine and Central Hospital of Maputo	CIBS FM&HCM/45/2014
United Kingdom	University of Liverpool, Liverpool School of Tropical Medicine	17-009

During the process of fieldwork, participants in the qualitative study provided informed consent before the start of any data collection; I consented the participants myself in all cases. All data collectors had received refresher training in properly and ethically dealing with gaining consent and using consent forms during the REACHOUT project.

Ethical issues identified in advance of the studies included:

- Sensitivity of costing data, particularly salaries: this proved to be highly variable in the study countries depending on whether salary data were transparently accessible for public sector positions in the country; there is a brief discussion of this in section 4.3.3 and 4.5.4. Local colleagues and co-authors were essential to obtaining these data. Where extra data such as details of benefits package were not available, we assumed a fixed percentage of the salary to make up for this.
- Participant time lost: this is always a concern with studies involving staff that have other functions in the healthcare system. However, I had very few interviews that involved health workers themselves; primarily I was speaking to policy makers and implementers. All interviewees were free to decline the interview, and to choose a location and time that was most suitable to their scheduling and confidentiality needs.

There were very limited concerns about study ethics posed by any of the IRBs.

3.4. Generalisability and transferability of results

As with any multi-setting study, explicit consideration of comparability of the sites and the relevance of the results beyond the study settings was fundamental to the methodological design and types of methods chosen to ensure comparison would be possible and meaningful (1). This is especially true when examining options for health system structuring (e.g. appropriate roles for CTC providers) because unlike in identifying the most effective clinical treatment for a disease, in health system interventions there may be multiple 'good' options that depend heavily on context to determine how well they work.

Generalisability and transferability are two terms for assessing the relevance of findings beyond study sites. These terms have been used differently by various research groups, not always correctly! Lack of generalisability is often wrongly described as a weakness of qualitative research, by people who understand the term to describe the statistical representativeness of a quantitative sample to the total population (also known as statistical generalisability) (2). However, statistical generalisability is only one type of generalisability. Firestone describes it as one of three types, with transferability or 'case-to-case transfer' as a second type of

generalisability and analytic generalisability, a type of theory verification using case studies to verify or refute, as the third (2–5). Building on this, in the complex adaptive health systems we are working in and on, it is unreasonable to expect linear, causal relationships even in a single setting. Greenhalgh et al. describe the need to understand and generate evidence in such settings, stating that characteristics of complexity-informed health systems research include "strong theory, flexible methods, pragmatic adaptation to emerging circumstances, contribution to generative learning and theoretical transferability" (6).

Box 1: Terms used for application of research findings beyond the study population

Generalisability speaks to the broadening of application of results from a sample or study population to a wider (more general) population. In this thesis, that might mean speaking to how the findings from one site (district, county, *woreda*) in a study country might guide national policy.

Transferability (7,8) addresses the relevance of results from one study site or population to another; for example, whether cost-effectiveness modelling from Kenya (presented in Chapter 5) is relevant to Malawian national policymakers.

In this thesis, we hope to fill evidence gaps about the costs, affordability, cost-effectiveness, and the use of evidence in priority setting – with knowledge that can be applied in the study countries and beyond, to inform choices on how to better design, support, and strengthen community health systems. This does not mean stating conclusively the value of one approach over another; it is a process of examining the range of choices available and the contextual aspects that might influence which choice is preferable in different places. In the next section 3.1.1 we describe some of the methods we have used to achieve this.

3.4.1. Methods to facilitate generalisability and transferability

To address the challenge of generating results that are relevant to non-study populations, I borrowed from the good practices utilised by the REACHOUT consortium. First, I used both qualitative and quantitative research methods at multiple levels of the health system from national to community level in the intervention countries to triangulate data. Second, the design was iterative to allow for both inter- and intra-country comparisons as well as depth and detail on what

worked for whom, where in the local contexts - using common objectives and a balance between common tools and methods on the one hand and contextualisation of implementation on the other. Finally, finding commonalities between a subset of study sites and then working to understand the similarities between those contexts that made them more alike (9,10) rather than assuming generalisability was an all-or-nothing concept.

To ensure sufficient depth of analysis and understanding of each study site, especially with the limitations on length that are imposed by a publication-based thesis, I leveraged the years of each REACHOUT research team's relationships, experiences and findings. This helped with understanding how the study location in each country related to the national population as well as allowing us to highlight relevant, specific aspects of context to allow evidence users in other locations to assess transferability. Having local research collaborators with thematic expertise in community health and working with them longitudinally over multiple years meant that I was able to build my research on their deep contextual knowledge. Formal and informal discussions of my findings with these teams helped to contextualise them and provided deeper understanding of the inter-relationship between some respondents. This was also beneficial in obtaining sensitive information (e.g. MoH salaries) that was important to ensure trustworthiness. However, these relationships may have also been limiting – when meeting with key informants, I was in many cases introduced and/or accompanied by my colleagues from the local research institutions. Inevitably, although confidentiality was assured, this might have meant that the respondents would be influenced by social desirability bias and their responses may have been coloured by this. These limitations are discussed further in Chapter 7, section 7.5, both in terms of their methodological limitations and my positionality as a researcher.

As CTC health workers become more integrated into health systems striving for UHC, decision makers are seeking reliable evidence that explicitly considers if and how findings apply to their context. This includes evidence that comes from and compares multiple settings and describes the role of context in intervention outcomes. Across implementation science and global health more broadly, teams are grappling with how to balance contextualization and fidelity, a core component of the intervention assessment framework shown in Figure 2.3 – how much can an intervention be

adapted for a given location to ensure success and still be described as the original intervention? What does Greenhalgh's 'pragmatic adaptation to emerging circumstances' really entail and what are the implications for generalisability(6)? Several recent publications describe methods and concepts that acknowledge, assess and address this tension, though no single approach is yet accepted as the gold standard. Abimbola and Topp examine the use of a specific term, 'resilience', in multiple countries and propose a universal definition as a means of both overcoming misunderstanding across contexts as well as proactive positioning of the term for improving health system functionality (11). Two frameworks for reporting modifications and assessing fidelity in health systems research were identified: first, the updated FRAME framework describes an improved approach to documenting adaptations and modifications to evidence-based interventions, reporting changes to a protocol on several different dimensions to ultimately assess fidelity (12). Second, the TIDieR checklist was modified from its original design to be applied outside of clinical trials and applied across six settings – the results from which were used to modify the checklist to incorporate more subjective measures such as 'voice' (who prepared the description) and 'how well' (describing impact of context on delivery) (13). Specific to QI, McNicholas et al. assess fidelity to PDSA in multiple sites over multiple cycles using mixed methods approaches and describe it rather than as a dichotomy but as something that may emerge over time (14). None of these perfect solutions, but they give a sense of the relevance of this thinking in the implementation research community community. With awareness of this Zeitgeist, I have considered these approaches to identify key aspects of context in my papers that may have influenced the results, helping others to be able to consider its relevance in their location or study site.

4. Is quality affordable for community health systems? Costs of integrating quality improvement into close-to-community health programmes in five low- and middle-income countries

This chapter is the first of a series of three and is the verbatim text of a published paper (43). The paper describes costs as the first step towards an economic evaluation of QI in community health systems. By collecting and analysing primary expenditure data from all the REACHOUT sites that implemented the intervention with a public sector CTC programme, the paper assesses three economic indicators: absolute costs of the intervention in different contexts, context-independent cost drivers, and budget impact of the programme if scaled up. It frames the costs in terms of multiple scenarios for local adoption and sustainability of the intervention based on observed differences in activity levels during the researcher-supported phase of the intervention and addresses affordability in context by looking at budget impact on general government health expenditure. Co-authors from each country supported the primary data collection and details of the intervention in context, gathering local salary and budget information, and the interpretation of the results, this collaboration is briefly described in Section 1.5. The published, formatted version of this paper is reproduced in Appendix 7 and supplementary material in Appendix 8.

Title: Is quality affordable for community health systems? Costs of integrating quality improvement into close-to-community health programmes in five low- and middle-income countries

Authors:

Meghan Bruce Kumar

Department of International Public Health, Liverpool School of Tropical Medicine, Pembroke Place, L3 5QA, UK; Emory University, Atlanta, GA USA

Correspondence to: Meghan.brucekumar@lstmed.ac.uk, +254 733440052

Jason Madan, Warwick Medical School, Warwick University, Coventry, UK

Aschenaki Z. Kea, School of Public and Environmental Health, Hawassa University, Hawassa, Ethiopia

Sozinho Ndima, Community Health Department, Faculty of Medicine, University Eduardo Mondlane, Maputo Mozambique

Ralalicia Limato, Eijkman-Oxford Clinical Research Unit, Jakarta Pusat, Indonesia

Maryline Mireku Achieng, Department of Research and Strategic Information, LVCT Health, Nairobi, Kenya

Kingsley Rex Chikaphupha, Research for Equity and Community Health (REACH) Trust, Lilongwe, Malawi

Edwine Barasa, Health Economics Research Unit, KEMRI-Wellcome Trust Research Programme, Nairobi, Kenya; Centre for Tropical Medicine, Nuffield Department of Clinical Medicine, University of Oxford, Oxford, UK

Miriam Taegtmeyer, Department of International Public Health, Liverpool School of Tropical Medicine, Liverpool, UK

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Author contributions

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Data collection, analysis, interpretation of results: MBK, AK, SN, LL, MM, KC

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Abbreviations

CTC	Close-to-community
MoH	Ministry of Health
PDSA	Plan-Do-Study-Act
QI	Quality improvement
UHC	Universal Health Coverage

4.1. Abstract

Introduction

Countries aspiring to Universal Health Coverage view close-to-community (CTC) providers as a low-cost means of increasing coverage. However, due to lack of coordination and unreliable funding, the quality of large-scale CTC healthcare provision is highly variable and routine data about service quality are not trustworthy. Quality improvement (QI) approaches are a means of addressing these issues, yet neither the costs nor the budget impact of integrating QI approaches into CTC programme costs have been assessed.

Methods

This paper examines the costs and budget impact of integrating QI into existing CTC health programmes in five countries (Ethiopia, Indonesia, Kenya, Malawi, Mozambique) between 2015 and 2017. The intervention involved: (1) QI team formation and (2) phased training interspersed with supportive supervision, which resulted in QI teams independently collecting and analysing data to conduct QI interventions. Project costs were collected using an ingredients approach from a health systems perspective. Based on project costs, costs of local adoption of the intervention were modelled under three implementation scenarios.

Results

Annualized economic unit costs ranged from $62 in Mozambique to $254 in Ethiopia per CTC provider supervised, driven by the context, type of community health model and the intensity of the intervention. The budget impact of Ministry-led QI for community health is estimated at 0.53% or less of the general government expenditure on health in all sites (and below 0.03% in three of the five countries).

Conclusion

CTC provision is a key component of health care provision in many settings, so QI has huge potential impact. The impact is difficult to establish conclusively, but as a first step we have provided evidence and context to assess affordability of QI for community health. Further research is needed to assess whether QI can achieve the level of benefits that would justify the required investment.

What is already known about this subject:

- The quality of CTC healthcare services is highly variable and routine programme data are of poor quality
- Quality of care provided by CTC providers can be improved through QI approaches and measures
- Stakeholders perceive QI approaches to be an additional and diversionary cost in resource-limited settings

What are the new findings:

- Across the countries studied, capital costs of training are similar across implementation scenarios and represent a large proportion of total cost of implementing QI approaches
- Recurrent economic costs of QI per CTC provider range from $54 in Mozambique to $233 in Ethiopia, driven by costs of staff and volunteer time
- The budget impact of national-scale QI for CTC programmes ranges from 0.03% to 0.58%

What are the recommendations for policy and practice:

- Sustainability of QI for CTC programs is likely affordable within budget constraints if capital costs of training are supported
- Systematic measuring of the benefits of QI on processes and outcomes should be a routine part of policy and practice to underpin investment decisions

4.2. Introduction

Many governments struggling to achieve universal health coverage (UHC) in resource-poor settings are considering expanding health care coverage at low-cost through the use of close-to-community (CTC) providers of healthcare (1,10,11,34,62,152). Composed of a wide range of typologies, CTC providers are lay health workers with relevant training for their responsibilities. They include: community health volunteers, community health (extension) workers, nutrition counsellors and traditional birth attendants, among others (8,11). CTC providers deliver a range of preventive, promotive and curative health care services at community level depending on context and policy (12,34,142) and have been found to be effective in expanding service coverage in certain contexts and clinical areas (29,49). However, CTC providers face numerous challenges working at the interface between communities and health systems due to factors such as: working remotely (where it can be difficult to maintain standards), lower literacy rates, higher attrition rates, less education and fewer support structures than other professional, formal cadres of healthcare workers more closely linked to the formal health sector (12,153). Additionally, efforts to consider quality at the health system or global level continue to leave out CTC providers and the potential contribution of the community level to health system goals (45,154,155).

Despite the perception that CTC provision of care is cheap, economic evaluation of the work of CTC providers and programmes is complex due to a unique combination of challenges. First, costing involving this cadre is complicated by its composition of primarily part-time and/or volunteer workers (who may pay out-of-pocket costs that are difficult to measure for food or transport to support the effectiveness of the programmes) (156). Second, drawing generalizable conclusions is also difficult as the responsibilities, training, supervision and remuneration of CTC providers between and even within countries vary widely (8,9). These challenges are not unique to CTC programmes, but this is an area where challenges are particularly numerous and acute. Additionally, cost-effectiveness studies rely on causal, proximal clinical outcomes to an intervention and high quality data (78,79). With community health, however, the long-term benefits of the primarily preventive and promotive services provided by CTC health workers are challenging to measure and to attribute

(77,157,158) and the quality of the data on both costs and benefits are questionable (75,159–161). Few studies and models to date have taken this complexity sufficiently into account to collect real-life data on the full set of services, focusing instead on a limited set of services and/or heavily on modelling (78,88,162).

Policymakers are beginning to question whether CTC providers can achieve equitable service quality at low cost (163). Evidence is growing for systematically incorporating quality improvement (QI) approaches into community health programmes in low- and middle-income countries, especially in maternal and child health (16,18,112,114,117). These community-level approaches appear to have been successful in terms of improving the quality and equity of services, but there is limited information about costs or cost-effectiveness of implementation (16,114). This lack of financial data acts as a barrier to decision makers, who may perceive the financial and time costs of incorporating QI approaches to be high when compared to the urgency of further expanding coverage and under pressure to show progress toward UHC.(164,165) We set out to examine the costs of integrating QI approaches in community health programmes at a mid-level of administration in Ethiopia, Indonesia, Kenya, Malawi, Mozambique, five countries with established community health programmes addressing maternal and/or child health among other priorities at CTC level through preventive and promotive care (Table 4.1). This study is a first, essential step towards assessing the cost-effectiveness of this approach.

4.3. Methods

We nested this costing within REACHOUT, a consortium of research partners in community health conducting an implementation research study addressing the feasibility and effectiveness of QI at community level (21). While the CTC providers' typology and responsibilities varied across the countries, we used a common approach to QI team establishment and training. Based on actual project costs, we have then taken a scenario planning approach to assess the costs and budget impact of a long-term Ministry of Health (MoH)-led adoption of this approach by public sector staff in each setting. We report (in 2017USD): total and annualized economic costs per country; total and average annual financial costs of the intervention per country; for the MoH-led adoption, we report the same and add the unit economic

and financial costs of intervention per: catchment population, CTC provider, QI team trained and administrative area. We also report the budget impact of national scale up of MoH-led QI.

4.3.1. The intervention

QI capacity development efforts were guided by a common approach across the study countries, as shown in Figure 4.1. In all settings, after curriculum development and adaptation of the training materials, QI teams made up of CTC providers, supervisors and health facility staff (average 8 people) were established. In Kenya and Ethiopia, project team and MoH partners decided in Step 3 to form QI teams at both the community and the district levels. These teams were trained in three phases to conduct QI for community health using Plan-Do-Study-Act (PDSA) cycles. PDSA approaches are characterized by local selection, prioritisation and action on quality problems identified from local data (71,166–169). Training content included: standards for quality in community health, quality assurance and quality improvement concepts, community health information systems, supportive supervision, etc. The three phases of training and exchange (implemented over 9-12 months) were interspersed with periods of implementation of QI by the teams, involving team meetings and interventions to improve quality supported by mentorship from supervisors, with the expectation that implementation could be continued indefinitely in what is termed “continuous QI”. Examples of QI priorities tackled include: improving timeliness of reporting by CHWs; improving follow up of pregnant women referred for antenatal care; reducing rates of unskilled delivery. These priorities were selected and improvement was measured by the teams using local community health information systems and data. Further details are provided in Table 4.1.

Table 4.1 QI change plans and activities by country

Country	Priority problem	Summary of change plan activities
Ethiopia	Poor quality of key maternal health services	Discussion meeting on supportive supervision experiences and planning for QI; training material development for refresher training with all HEWs in catchment on maternal health (danger signs, referral, monitoring, etc.); 3-day training and follow up in supervisions
Indonesia	Village midwives' non adherence to SOPs for treatment of pregnant women	Printing of SOPs for each midwife; refresher during monthly group supervision meetings; regular follow up in individual supervisions and
Kenya	Poor data completeness in MoH 514 household activity register	Training material development; 3-day training on activities and completion of data tools; community dialogues to sensitise community members on services to demand/expect
Malawi	Community case management sections in health surveillance assistants' summary forms contain incomplete, inaccurate and/or untimely data	Development of data checklist by district health teams; site visits to link facilities including catchment community workers; improvement of physical data storage at facilities and training on data to community data collectors
Mozambique	Poor referral documentation and limited supervision	Advocating the use of referral slips for feedback with other health professionals; coordination of external resources to ensure field supervision happens and includes community level (not single programme only)

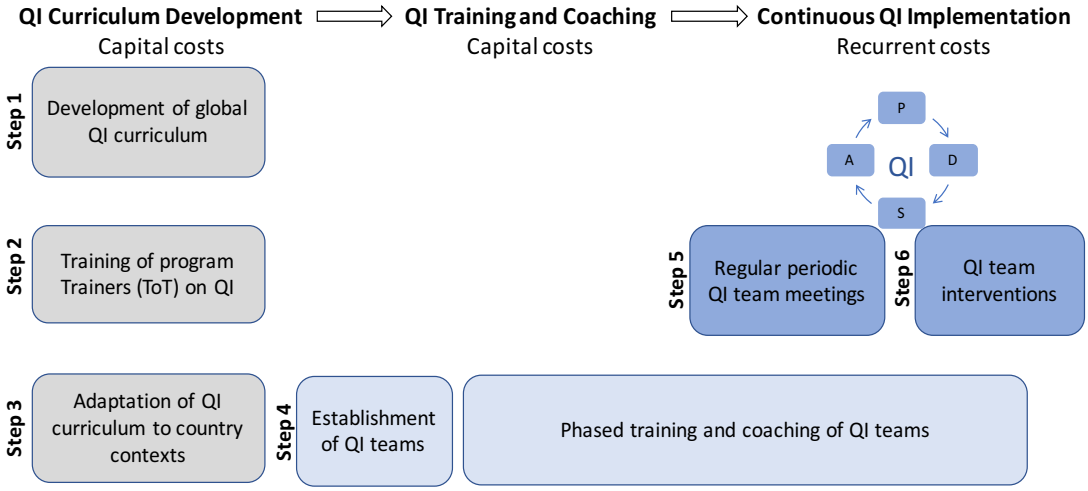

Figure 4.1: Common approach to capacity development for quality improvement for CTC healthcare across countries

4.3.2. Study site selection

The common approach to QI in community health was implemented with 21 QI teams in 11 administrative areas of the five countries serving a total of 1.6 million people in their catchment areas. In each country, study sites were selected for the QI intervention in collaboration with stakeholders from the community and Ministry of Health building on earlier supportive supervision interventions for the CTC programs (see Table 4.2). Further description of the CTC provider typologies in each of the study sites including selection, training, and responsibilities can be found in Supplementary File 1 (170).

Table 4.2: Intervention sites for quality improvement capacity development intervention[1]

Country *Region*	**Administrative unit** (district or equivalent)	**QI teams**	**Setting**	**Catchment population**	**CTC providers**	**# of CTC providers supervised**	**Focus of CTC program**	**Policy ratio of CTC providers to population**
Ethiopia *Southern Nations, Nationalities and Peoples' Region, Sidama Zone*	Shebedino *woreda**	1 Community QI team at *woreda** level 9 Community QI teams covering health centre catchments: Abela health centre Galuko-hirreye health centre Gebre-kirstos health centre Mero kawado health centre Telamo health centre Fura health centre Dobe toga health centre Morocho negasha health centre Dulacha health centre	Rural, medium-remote	244,489	Health extension workers	68	Preventive Curative Family Planning	2:5000
Indonesia *Cianjur district*	Cianjur district	4 Community QI teams covering three *puskesmas* Cikalongkulon *Pukesmas* Ciranjang 1 *Pukesmas* Ciranjang 2 *Pukesmas* Gekbrong *Pukesmas*	Sub-urban, medium-remote	188,323	*puskesmas* midwives	47	Maternal health (incl. delivery)	~1:5000-6000 general population (but serve women)

[1] References for *Table 4.1: Intervention sites for QI capacity development* (174,175,201,263,370,375,380)

Country *Region*	**Administrative unit** (district or equivalent)	**QI teams**	**Setting**	**Catchment population**	**CTC providers**	**# of CTC providers supervised**	**Focus of CTC program**	**Policy ratio of CTC providers to population**
Kenya *Nairobi county*	Embakasi West sub-county Kasarani sub-county Lang'ata sub-county	3 Community QI teams at sub-county 9 Community QI teams covering community units: Maili Saba Unit Bangladesh Unit Southlands Unit Raila Unit Gitari Marigu Unit Housing Development Dept Unit City Carton Unit Matopeni Unit Ribakia Unit	Urban, non-remote	737,460	Community health volunteers Community health extension workers	1530	Preventive	1:500 1:2500
Malawi	Mchinji, Salima districts	2 Community QI teams at district level	Rural, remote	213,206	Health surveillance assistants	121	Preventive Curative	1:1000
Mozambique *Maputo province*	Manhiça, Moamba districts	2 Community QI teams at district level	Rural, non-remote	214,388	Agentes polivalentes elementares	68	Preventive Curative	~1:500-2000

* *Woreda* is the Amharic word for district, at the level below Zone in the Ethiopian health system.
***Puskesmas* is the Bahasa word for community health facility

4.3.3. Costing approach

The costing took a health systems perspective, taking into account health system resource and time costs (we differentiate that from health system costs, as CTC providers may not be salaried individuals whose time is explicitly valued by the health system) (171,172). Specifically, we collected and report both economic and financial costs of the intervention, as well as the budget impact of national scale up based on the financial costs only. Financial costs refer to outlay of money; economic costs encompass financial costs and opportunity costs of time, even where people are already salaried or are volunteers and their time is 'free'. An ingredients approach was used to assess the costs of each phase of the intervention in the following categories: staff time (encompasses volunteer time), lodging/ transport, communication, venue, refreshment, stationery (173). In our model, costs incurred during the training are treated as capital costs while the QI implementation represents recurrent costs of the intervention. The useful life of the training is taken as four years (i.e. all participating staff would receive full re-training in Year 5). Details of specific cost adjustments made at each of the steps of the intervention when calculating country costs can be found in Supplementary File 2.

Data on the actual costs in local currency of QI capacity development and functioning were collected retrospectively (Mar-Jul 2017) from country research teams using a combination of structured questionnaire on activities and a spreadsheet for unit resource costs (Supplementary Files 3 and 4). Project costings for consumables were calculated by multiplying units of resources consumed by market rates in May 2017. For other categories, i.e. salaries, venue, transport, communication, actual project expenses incurred were used. Data were provided by implementation and finance team members from each REACHOUT country partner institution and validity of data was confirmed through back-checking financial reporting and audited information. Salaries for the public sector staff involved in intervention activities were obtained from public documents referenced here; where not available they were estimated from available data (174–179). Where available, actual value of employment benefits were used. Where not available, an assumption of 15% of salary was applied. We excluded outcome-related costs, e.g. costs averted due to improved health, as outside the scope of the study.

Annual costs are reported in 2017 USD and exchange rates from May 2017 were used.(180) For details of cost adjustments made at each of the steps of the intervention when calculating country costs, see Supplementary File 2 (NB country costs cannot be added together to compute the actual total project cost due to these adjustments). A discount rate of 3% was applied to future costs; because inflation was only relevant to the development costs (sunk costs), this is not accounted for in the model. Data were input and managed in Microsoft Excel version 15.32.

4.3.4. Scenario planning and sensitivity analysis

Based on project costing, we present three scenarios for adoption of the intervention in each country, which we term "MoH-led QI". These scenarios assume the intervention were to be repeated across the same administrative area and population as the project-led approach. Specifically, we present the economic costs of MoH-led QI per administrative area of the intervention (Table 4.1) by step of the intervention (Figure 4.1). Where multiple levels of QI teams were involved (i.e. in Kenya and Ethiopia), we have included costs for both and described this as increased intensity of intervention.

All scenarios for MoH-led QI involved the following modifications to the project costs: (1) dropping all development costs in Steps 1-3 as sunk costs incurred by REACHOUT; (2) health system staff acting as trainers leading Step 4; (3) periodic mentorship at quarterly QI team meetings Step 5. Deterministic sensitivity analyses were conducted around a 'best' and 'worst' case scenario for MoH-led QI, based on the level involvement required of project staff in the scale up and the frequency of QI team meetings and interventions (Supplementary File 5 for details).

4.3.5. Budget impact analysis

Budget impact analysis was conducted by comparing the financial costs of MoH-led QI, scaled up linearly to national level based on the total number of administrative areas in the country, with the annual general government expenditure on health (GGHE). GGHE was chosen as a comparator for the budget impact analysis for two reasons: first, financing for community QI is unlikely to be a repurposing of community/preventive care budgets. In part, this is due to the reliance on unpaid or

low-paid staff in current community/preventive care budgets, making this a misleading comparison (in addition to the variability in pay levels for CTC providers between contexts). Also, what is proposed is a systemic change to the health system, given how CTC providers are used (across a broad spectrum of health areas) and could be supported by general government funding. The argument is for government investment, so need to compare with GGHE. Secondly, as community/preventive care budgets are often not earmarked in externally available documents, using these as the basis of budget impact analysis would require us to estimate a percentage of GGHE rather than relying on empirical data. Specific analyses for each health system or even budget-holding unit with more granular data would still be required for ultimate financing decisions– this analysis is indicative of broader trends in investment in community health systems and quality across systems.

GGHE data were obtained from the National Health Accounts database (on 6 October 2017)(181) and inflated from 2014USD (the most recent year to have complete data) to 2017USD (182), assuming no change in expenditure over these three years as GGHE as a portion of total government expenditure has remained constant for some time. We have not included salaries of public sector staff as financial costs in the budget impact analysis because no additional staff were hired to conduct the QI activities.

4.3.6. Ethical approval

Institutional Review was conducted and approval obtained from the Liverpool School of Tropical Medicine under protocol 14.007. Country research activities described herein were also governed under national approvals; details available in Supplementary File 6.

4.3.7. Patient and public involvement

Co-development of research questions in the wider REACHOUT study was done with relevant government counterparts and community health stakeholders in each country; patients were not directly involved in any way. Results will be disseminated to participants through technical working groups in each country as relevant. Detailed economic data are made available at

https://doi.org/10.6084/m9.figshare.12648881.v1.

4.4. Results

4.4.1. Total costs of project-led QI intervention

The economic costs of developing the intervention, establishing and training 29 QI teams, and mentoring those teams through one completed QI cycle were incurred across the 11 administrative areas in the five countries as part of the REACHOUT project. These ranged from $11,351.32 (Mozambique) to $333,589.89 (Kenya) and show the full costs of the dedicated technical project teams, curriculum development and training. When aggregated across countries, costs of conducting the three phases of training made up about 70% of the total costs and were driven largely by people-time and by the intensive, phased nature of the training. Training costs varied widely between the five countries and were greatest in Kenya at $267,111 (where the highest number (12) of teams were trained), and were least in Indonesia at $3,868, where the project team limited costs of this phase through use of available public sector venues. The total recurrent costs of implementation across countries (incurred in QI team meetings and QI interventions) were similar to development costs in Year 1 (15-16% of the total costs).

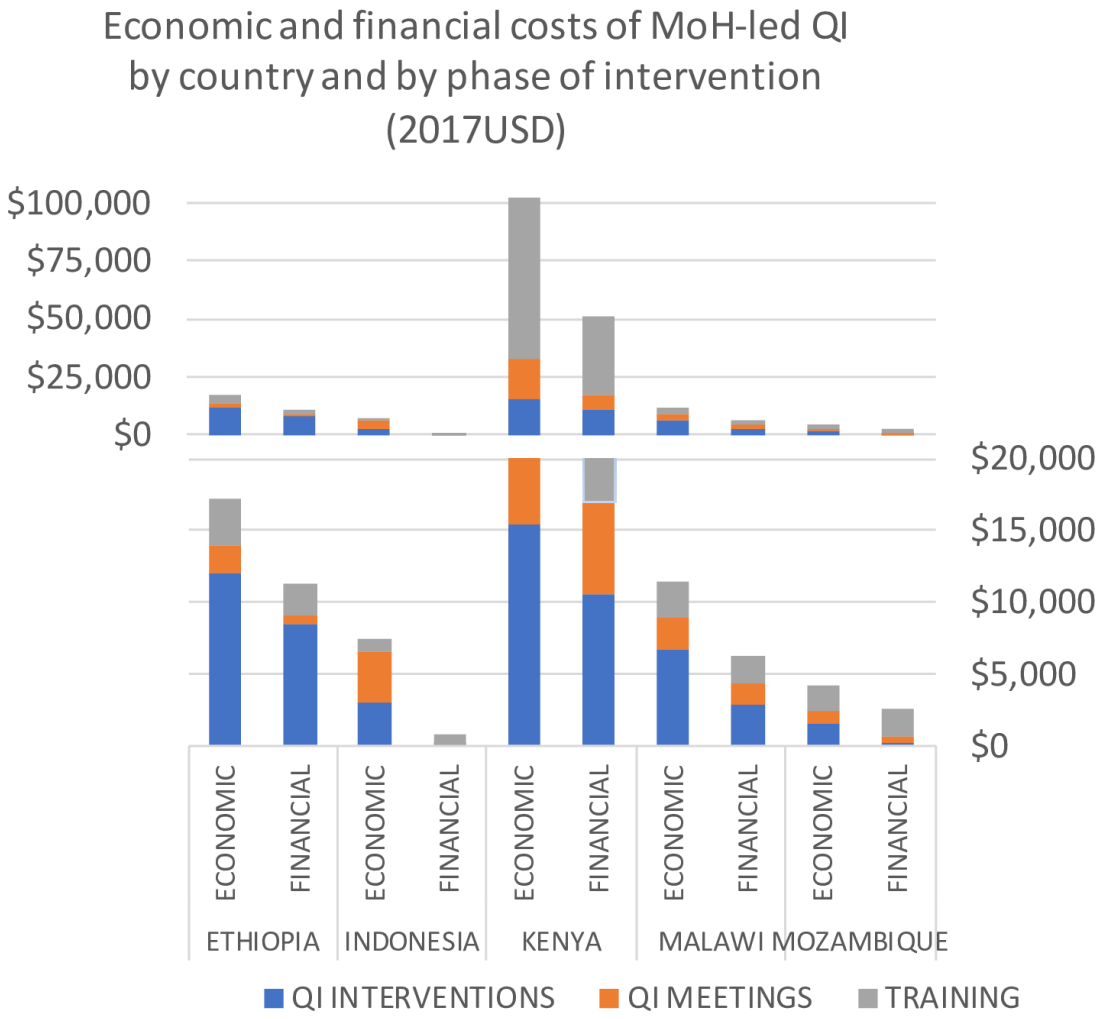

Figure 4.2: Economic and financial costs of MoH-led QI by country and by phase of intervention (2017US$)

4.4.2. Total costs of MoH adoption of QI intervention

When MoH-led adoption of the QI approach is modelled for the same sites, the economic costs per administrative district are less than the project-incurred costs in each country, showing that unit costs of the intervention were higher for the project than those that would be faced by local decision makers. The annualised economic costs range from $4,250.07 in Mozambique to $102,339.98 in Kenya (see Table 4.3 for country costs for the first year of implementation by input category and Table 4.4 for details of annualised country costs by phase of intervention). In sites where teams deliberately selected or prioritized QI problems that could be solved at low-cost without enhanced project budget, the capital costs of training (incurred in year one) represent a larger percentage of the total spend. Ethiopian and Malawian project

teams provided additional external “project funds” to the QI teams to when addressing problems (to cover items such as venue for refresher training of CTC providers, transportation for QI team to visit field facility sites and test new tools), which impacted implementation costs. The average annual financial costs are lower in all sites than the annualised economic costs, as expected (Figure 4.2). This is because a QI approach to community health requires an ongoing investment of time from existing staff in the form of trainings and meetings.

The overall costs of MoH-led QI show high inter-country variability (Figure 4.2, in part due to the differences in the sites (Table 4.2) in terms of geography, population density, and the wage differential. In Kenya and Ethiopia where two levels of QI teams were formed, the impact on cost is demonstrated in a high resource level difference in both sites, as well as a high unit cost per CTC provider supervised in Ethiopia and a high unit cost per QI team member trained in Kenya.

Table 4.3: Costs of adoption in the first year of implementation by input category and by country

Cost category	Base case adoption costs (2017USD) per category of inputs by country				
	Ethiopia	Indonesia	Kenya	Malawi	Mozambique
Person time	$ 6,515.25	$ 74,149.87	$ 2,519.30	$ 9,311.06	$ 5,809.97
Venue/refreshments	$ 406.80	$ 3,434.76	$ 92.97	$ 2,587.06	$ 375.10
Communication	$ 114.14	$ 26,974.28	$ 83.98	$ 988.05	$ 654.60
Stationery, hardware	$ 8.88	$ 436.16	$ -	$ 146.28	$ 35.46
Transportation	$ 967.99	$ 25,045.29	$ 1,390.97	$ 3,854.34	$ 2,663.63

Based on the scenarios described in Supplementary File 5, active adoption (i.e. greater ownership by public sector staff in training and more frequent QI interventions) drove up the annualized economic costs in each country by 7-21% while more passive adoption led to decreased costs of 67% - 92% of the base case, with the greatest variability observed in Indonesia and Malawi (Supplementary File 7). Training, which is a relatively static cost across scenarios, represented a smaller proportion of the costs in these two sites, increasing sensitivity to the different levels of activity in the intervention phase.

4.4.3. Unit costs of MoH-led QI for community health

As shown in Table 4.4, the costs of MoH-led QI per capita are between <0.01-0.5 (financial) and 0.02-0.14 (economic). The annualized economic costs per administrative area are between $2,125 (Mozambique) – $34,113 (Kenya). Despite that variation, the annualized economic costs per CTC provider supervised are much closer, ranging from $62 (Mozambique) to $254 (Ethiopia). Mozambique presents the lowest economic costs overall and economic unit costs in all cases except per QI team trained, for which unit costs in Indonesia and Ethiopia are lowest (Table 4.4). The average financial cost per CTC provider supervised ranges from $12 in Indonesia to $166 in Ethiopia.

In both Ethiopia and Kenya, the intensity of the intervention was much greater, involving formation of two levels: district-equivalent QI teams and community QI teams. Ethiopia was the most expensive site in which to embed the intervention across the key indicators of cost per CTC providers supervised. The number of health extension workers in Shebedino *woreda* is almost equivalent to the number of QI team members, so these unit costs appear very close. The Ethiopian costs are dominated by the cost-heavy intervention that was chosen by the woreda (district) community QI team, which was a four-day refresher training exercise. In Nairobi, the site of the Kenyan intervention and the other outlier due to cost, high density of both CTC providers and population make it appear high-cost at the administrative unit level, yet more affordable at these more granular unit levels (Table 4.4). Mozambique had the least expensive intervention in terms of absolute costs and this remained true across all indicators. Indonesia, as the only Asian context, was the

least expensive site to conduct the intervention financially, showing similar cost structures and constraints despite very different geography and health system structures.

4.4.4. Budget impact of MoH-led QI for community health

Annual government spending on health ranged from 15-16USD per capita in Ethiopia and Malawi to 49 USD per capita in Kenya, whereas the annualized financial costs of MoH-led QI is between <0.01 to 0.05 USD per capita. Based on scaling up the average annual financial costs of the intervention per administrative district to nationwide coverage, the budget impact of MoH-led QI for community health represents less than 0.53% of the GGHE in all countries. The impact of MoH-led QI on annual government budgets varies somewhat by these levels of health expenditure, as Ethiopia has the lowest GGHE and the highest costs, so shows the greatest budget impact, though still low (at 0.53%). In Kenya, the other study site that implemented 'two-level' community QI, budget impact of national-scale community QI is 0.16% of GGHE, and in the three other study countries the budget impact is 0.03% or less of GGHE. Also relevant to budgeting is the fact that the financial outlay would be greatest in Year 1, when the training occurs, with low recurrent financial outlay; after annualized this variation is masked.

Table 4.4: Financial and economic costs of Ministry of Health-led quality improvement for community health in each country[2]

Country	Financial costs			Unit annualized financial costs per:				
	Capital costs of training	Annual recurrent costs	Average annual cost	Administrative area	QI team trained	QI team member	CTC provider supervised	Capita
Ethiopia	8,509.25	9,034.92	11,324.13	11,324.13	1,258.24	179.75	166.53	0.05
Indonesia	2,008.98	62.15	602.62	200.87	150.65	20.78	12.82	0.00
Kenya	84,853.87	16,938.84	39,766.82	13,255.61	3,313.90	414.24	25.99	0.05
Malawi	4,878.76	4,316.62	5,629.14	2,814.57	2,814.57	201.04	46.52	0.03
Mozambique	4,963.79	588.03	1,923.42	961.71	961.71	83.63	28.29	0.01

Country	Economic costs			Unit annualized economic cost per:				
	Capital costs of training	Annual recurrent costs	Annualized cost	Administrative area	QI team trained	QI team member	CTC provider supervised	Capita
Ethiopia	12,326.54	13,959.67	17,275.84	17,275.84	1,919.54	274.22	254.06	0.07
Indonesia	3,371.14	6,536.81	7,443.74	2,481.25	1,860.94	256.68	158.38	0.03
Kenya	259,211.01	32,605.21	102,339.98	34,113.33	8,528.33	1,066.04	66.89	0.14
Malawi	9,210.99	8,932.05	11,410.06	5,705.03	5,705.03	407.50	94.30	0.05
Mozambique	7,001.19	2,366.56	4,250.07	2,125.03	2,125.03	184.79	62.50	0.02

[2] Reported in 2017 USD

4.5. Discussion

4.5.1. Summary of findings

We found that the economic costs of integrating QI approaches into community health range from $62 - $254 per CTC provider, with the most expensive unit cost incurred in Ethiopia. Collecting costs was a complicated exercise across the countries and inter-country variability was high. The largest component of costs of our phased training model were capital costs of capacity development generated in the training portion of the intervention, with the largest component of the cost being the time of existing public sector staff. In sites reporting high financial outlays, these were driven in part by the selection of venues and trainers, as well as general higher cost of living particularly in Nairobi. Greater intensity of the intervention (i.e. two levels of QI teams; more teams per administrative area) was correlated to greater cost, both economic and financial. In Ethiopia, Kenya and Malawi, QI interventions drove up costs as teams were provided additional financing to use for interventions rather than working within existing resources. Across settings, national scale up of the approach would have a budget impact of between 0.02-0.03% (in Indonesia, Malawi, Mozambique) up to 0.16% (Kenya) and 0.53% (Ethiopia) relative to the general government expenditure on health.

4.5.2. Sustainability of the approach

Sustaining QI approaches (or “MoH-led QI”) for community health will depend on financial commitment to take on recurrent costs by the sub-national administrative units and national decision makers. In Malawi, Kenya, and Indonesia, study countries with some decentralization of health financing allocation decisions, the district (or equivalent administrative) level management has indicated a commitment to allocate funds to cover the recurrent costs for the year following the end of the project-led intervention. This financial commitment would likely come from the general health budget rather than the community health or preventive care budget, which is misleading in its size – it relies on unpaid or under-paid staff, the specifics of which varies by country, as well as heavy external financing. Because this is a system-wide change to the health system, given that CTC providers are used across a broad

range of health areas and are a cadre of human resources for health, the argument for government investment is beyond the community budget to the general government expenditure on health. Given wide range of services offered and benefits of high-quality CTC care, a societal perspective might be optimal (62,87,153,183), but benefits are beyond the scope of this study.

Despite limited budget impact of this intervention, workload may be a challenge to the recurrent time costs. Time is a non-financial outlay, which is positive for the inclusion of the approach into local budgets going forward, although it may present challenges related to workload of mid-level health systems management staff. A reduction in meeting frequency may be feasible after the initial intensive start-up/mentorship phase of implementation to reduce recurrent time costs as well as financial costs; in the base case, we used a quarterly frequency to reflect this (rather than the original monthly design). However, as Greenhalgh et al. write, diffusion of effective innovations in high-functioning health service delivery organizations is a notorious challenge (184), so it is likely to be a greater challenge where resources are limited.

The project-led intervention has been conducted on a pilot scale in each country, so it is not known whether these unit costs are similar at scale or whether economies of scale or scope might be achieved (185). The use of budget impact analysis was an attempt to address affordability at scale (186). In looking at affordability of scale up, the costs of the phased training and mentorship intrinsic to the intervention design as described are higher than a traditional one-off workshop training. Reduced costs for training might also be achieved by inclusion of the QI material into in-service training for CTC providers and supervisors. Another option is a one-time external investment to cover training costs that would then be sustained by leveraging domestic co-financing for the recurrent costs.

4.5.3. Benefits of the QI approach can be difficult to capture

For policymakers and donors to be convinced by costing data, they must first be convinced of the benefits of what is being costed, and this has created a challenge for QI approaches generally. We have not presented data on the individual improvements achieved by the 29 improvement teams included in our study, which

are similar those observed by other community QI projects from several settings in sub-Saharan Africa (16,18,111–114,118–120). Immediate process outcomes of the QI approach we used included: improved supervision and integration of community health programs to the health system, consensus building across levels of the health system on priority problems, and improved data quality on critical health service areas – all of which have been shown to support improved performance of CTC providers (12,25,26,34,170). The health impacts of integrating QI are harder to attribute due to the complex, iterative and locally-driven nature of the approach. Measuring and attributing the downstream benefits of a service delivery intervention that are intrinsically valuable to a decision maker or population is challenging (90,123,157,187–189). Adding to the challenges of potential confounding, in "Step Six" of the intervention (Figure 4.1), QI teams have the freedom to design and test QI interventions to address locally-relevant problems they select (in contrast to having a standard QI intervention imposed by higher-level or external stakeholders). These have greater potential to directly affect and yield benefits in priority health areas. However, this freedom or choice makes it challenging to evaluate outcomes systematically across intervention sites, as they are likely to be yielded in different health areas depending on the QI intervention selected by each QI team.

Community health services are often a low priority for domestic investment in health systems despite being shown to be cost-effective (52,78,79,88). The interventions that are funded out of the health budget are more often those that are most visible (facilities, ambulances) or urgent and curative (tertiary care) that can show immediate impact and benefit to the politician, rather than those with longer-term population-wide benefits like community health and preventive services (139). Where funded, the focus of investment in community health has been on increasing coverage toward UHC with limited emphasis on quality. Here we show that with a small additional investment, coverage of the population by CTC providers can potentially be transformed into meaningful coverage through improved performance and stronger linkages to higher-level healthcare services and providers.

For countries where this QI approach has been piloted through the REACHOUT project, the policy implications of affordability need to be contextualized beyond what is presented in the budget impact analysis here. Sub-national 'use cases' for adoption of this QI approach are being developed jointly with national policymakers. These cases will bring out multiple feasible locally-relevant scenarios for adoption and scale up of the approach, considering current staffing ratios, strategy development and budget cycles. Following on from discussions of affordability, assessment of whether QI for community health is a good investment requires a quantification of the benefits yielded by the intervention coupled with this cost analysis. To assess cost-effectiveness and relevance to UHC, further data on benefits derived from the intervention is required as well as an assessment of the reach of those benefits on the target population. Further, a qualitative exploration of decision space for the various funders of community health and their values in terms of benefits is planned to supplement the findings of this study building on the abovementioned work by McCollum et al. (139).

4.5.4. Strengths and limitations of the study

Having robust, primary cost data collected and compared across countries and specifically looking at quality of care is very valuable, given the global focus on quality under UHC (45,153,154,190,191). At the same time, a major limitation of this (any) inter-country analysis is the differences in contexts. Variations in health systems, administrative units, CTC provider tasks and typology (Supplementary File 1) were easier to identify and describe than aspects of hierarchy, expectations of training allowances, donor and project fatigue but these less tangible aspects also affect the design and cost of getting a QI approach for community health to work. Nevertheless, findings around affordability and cost-drivers were robust across contexts. We emphasised contextualization of the intervention to each country, encouraging them to adapt while maintaining fidelity to the intervention design within a given set of restrictions (192–194). In Step Three (Figure 4.1), the intervention explicitly asked teams to adapt the global curriculum as appropriate to their context, bringing in local trainers and approaches as well as modifying the composition of the QI teams to best reflect existing health system structure, management, and reporting lines. This is

most clearly exemplified by the varied intensity of the intervention in Ethiopia and Kenya as compared to the other three settings, in addition to minor modifications due to variations in health system structures and supervisory approaches.

Significant challenges were faced in three of the five countries to estimate the costs of participation of public sector staff (as trainees and facilitators) due to sensitivity around salary data. In Malawi, public sector salaries were not publicly available and we received confidential estimates from multiple sources in addition to the limited public reference data. In Indonesia, the range of salaries within each tier is wide, reflecting the years of service of the individual more strongly than their level of responsibility. In Kenya, public sector expenses for participation in trainings were split into several categories (per diem, dinner allowance, workshop sitting allowance, local transport allowance). These were additional to the costs of mobilization (referring to the phoning and follow up with supervisees to ensure attendance) and facilitation but not applicable to all, making the actual costs of participation in training difficult to calculate but possible to estimate. In contrast, in Ethiopia and Mozambique public sector staff salaries are publicly available and presented no difficulty. The sensitivity around salary information reflects both transparency by the government and cultural values related to money and privacy.

4.6. Conclusion

CTC providers are a key component of healthcare provision in many settings. QI for community health has the possibility of bringing CTC providers more definitively under the umbrella of human resources for health, better aligning community interests with the health system's work. By integrating QI into community health services, policymakers hope to ensure the quality of the services delivered is being measured and improved (where required), leading to increased demand-side confidence in and utilization of these services. As a first step towards assessing whether QI for CTC healthcare services is affordable, we have provided a detailed breakdown of the costs of community level QI. Further research is needed to assess whether this type of intervention can achieve the level of benefits required to justify

this investment, as decision makers work towards the domestic and global goals of universal access to high-quality healthcare services.

5. Cost-effectiveness analysis of community health systems strengthening: a community-level quality improvement approach for antenatal care in Kenya

This chapter is the second of a series of three papers and has been submitted for publication in BMJ Global Health, following on from Chapter 4 (published in the same journal). This paper takes the next step toward a full economic evaluation; namely, assessing the benefits or outcomes of community QI. This required a modelling approach, as the intervention was not implemented with a control; however, we were able to used primary data from household surveys conducted in the Kenyan implementation to assess the impact of the intervention on key maternal health policy outcomes, early antenatal care attendance and skilled birth attendance. We take a case example of antenatal care in Kenya as the health area from which we will estimate or model the impact of QI on health outcomes as a complex service delivery intervention. In the decision trees, we use the costing data presented in chapter 4 (from Kenya only) along with the modelled outcomes to assess cost-effectiveness. In the discussion, we consider the relevance and utility of these data for decision makers. Supplementary material submitted with this manuscript to the journal can be found in Appendix 9.

Title: Cost-effectiveness analysis of community health systems strengthening: a community-level quality improvement approach for antenatal care in Kenya

Authors:
Meghan Bruce Kumar
Department of International Public Health, Liverpool School of Tropical Medicine, Pembroke Place, L3 5QA, UK; Center for Humanitarian Emergencies, Rollins School of Public Health, Emory University
Correspondence to: Meghan.brucekumar@lstmed.ac.uk, +254 733440052

Jason Madan, Warwick Medical School, Warwick University, Coventry, UK

Peter Auguste, Warwick Medical School, Warwick University, Coventry, UK

Miriam Taegtmeyer, Department of International Public Health, Liverpool School of Tropical Medicine, Liverpool, UK; Tropical and Infectious Disease Unit, Royal Liverpool University Hospital, Prescot Street, Liverpool, L7 8XP, UK

Lilian Otiso, LVCT Health, Nairobi, Kenya

Christian Ochieng, Department of Research and Strategic Information, LVCT Health, Nairobi, Kenya

Nelly Muturi, Department of Research and Strategic Information, LVCT Health, Nairobi, Kenya

Elizabeth Mgamb, Department of Health, Migori County, Kenya

Edwine Barasa, KEMRI-Wellcome Trust Research Program, Nairobi, Kenya;
Centre for Tropical Medicine, Nuffield Department of Clinical Medicine, Oxford University, Oxford, UK

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Competing interests
The authors declare no competing interests.

Author contributions
Study design and measures: MBK, JM, MT, EB, EM
Data collection: MBK, EM, LO
Data analysis: MBK, PA, CO LO, MT
Interpretation of results: MBK, JM, MT, LO, EM, EB
Drafting of manuscript: MBK, JM, MT, EB
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5.1. Abstract

Introduction

Improvement of maternal and infant health outcomes are policy priorities for Kenya dependent on early identification of pregnancy and quality of care at community and health facility levels. The use of quality improvement approaches has been shown to contribute to improvement in these health areas in Kenya and other settings, but as yet have not undergone economic evaluation. In this study, we evaluate the cost-effectiveness of quality improvement in community health systems to improve uptake of antenatal care (ANC) and skilled birth attendance in Kenya.

Methods

Using a decision tree model and taking a health system perspective, we estimated the cost-effectiveness of quality improvement compared to standard of care on the antenatal mother's pathway of care. We used both process (ANC initiation in first trimester and skilled delivery) and health outcomes (maternal and infant deaths averted, as well as disability-affected life years (DALYs)) as our effectiveness measures and actual implementation costs, discounting costs only. We conducted probabilistic sensitivity analysis using a Monte Carlo simulation with 1000 runs.

Results

We found that community quality improvement intervention was more cost-effective compared to standard community health care, with incremental cost per DALY averted of $249.43 under the deterministic analysis and 76% likelihood of cost-effectiveness under the probabilistic sensitivity analysis using a standard threshold. The deterministic estimate of incremental cost per additional skilled delivery was US$9.58; per additional early ANC presentation US$154.69; per maternal death averted US$5,654.19 and per infant death averted US$37,535.78 (2017 dollars).

Conclusions

This analysis shows that the community quality improvement intervention was cost-effective compared to the standard community health care in Kenya when assessed relative to maternal health. It is likely quality improvement would yield benefits in other health areas

What is already known?

- Maternal and infant outcomes are improved when pregnancies are identified early and quality of antenatal care is high, but these are not being achieved consistently in Kenya
- Quality improvement is feasible and low cost to implement at community level in resource-limited health systems

What are the new findings?

- Investment in community quality improvement can yield benefits in both maternal and child health outcomes
- The cost per DALY averted by the intervention is US$249.43 in Kenya
- Quality improvement at community level is cost-effective in the Kenyan healthcare system

What do the new findings imply?

- Investment in quality of community healthcare is an important component of the commitment to universal health coverage in Kenya
- Measuring the benefits of health system strengthening interventions can be convincingly done through attribution of benefits from a specific health area if thresholds are achieved

5.2. Introduction

Improvement of maternal and newborn health and reduction of maternal mortality is a major policy priority in Kenya, with a national transition to free maternity care since 2013 (195,196). The policy and implementation priorities for achieving this improvement are simple, proven interventions: early, focused and frequent antenatal care (ANC); and attendance at delivery by skilled birth attendants. Yet maternal mortality has remained persistently high in Kenya, despite recent efforts, and inequities are persistent between regions, especially among the younger and poorer mothers (197–199).

Community health volunteers in Kenya are expected to identify pregnant women in their communities who have not yet attended ANC or have defaulted on their scheduled visits, as well as informing women and their families on the benefits of skilled birth attendance and supporting them with individual birth planning. After birth, community health volunteers follow up newly delivered mothers with postnatal home visits and provide information and follow up regarding nutrition and immunisation. The volunteers work with and are supervised by a salaried community health extension worker from a primary care facility to assist with tracking individuals and to improve maternal and neonatal health outcomes. Community units, which include both the community health volunteers and extension workers, form the lowest level of the four-tiered Kenyan health system. This is underpinned by a community health policy that is linked to the Health Sector Strategic Plan (200,201). This broad, national strategy to community health is variably enacted by sub-national County governments as a part of the devolution of health decision making powers in health that came from the Kenyan Constitution of 2011 (139,141,201).

As countries grapple with defining and achieving Universal Health Coverage (UHC), the importance of quality at all levels of the healthcare system is increasingly recognized – except at community level (47). Recent research has highlighted gaps and barriers to high-quality healthcare and the downstream impacts of poor quality on morbidity and mortality, showing the need for advocacy, accountability and improvement in healthcare quality (44,45,202–204). Defining and measuring quality at community level in low-resource settings is a difficult, but essential, precursor to understanding coverage and performance of services and to identifying areas for improvement (72,159,205–208).

Quality improvement (QI) is a structured, cyclical management process often characterized by Plan-Do-Study-Act (PDSA) cycles, though this is by no means the only approach (209). In

health, the PDSA approach to QI is considered a health systems strengthening intervention and has been applied to identifying and addressing quality problems in many disease areas and contexts in health facilities (13,71,210,211). At the community level in low- and middle-income countries (LMICs), it has been used in a limited but growing number of cases to address a range of health areas, such as HIV, maternal health, and child health (111,113,114,116). The type of quality problems that can be addressed by community QI teams vary by the expected responsibilities of the health workers; community health workers in most countries focus on maternal and child health issues, as well as some disease-specific roles depending on context and programme design (9,212). Evaluations of pilots of community-level QI at have focused on assessing feasibility of continuous QI implementation given capacity of health workers at that level operating within the constraints inherent to the LMIC health systems in which the intervention was embedded (213,214). To our knowledge, community QI in LMICs has not undergone a full economic evaluation.

The aim of this paper is to evaluate the cost-effectiveness of community-level QI in Kenya. Specifically, the health system strengthening approach to QI studied was a capacity development intervention delivered to two levels (community and sub-county) of the Kenyan health system. At each level, QI teams established as part of the REACHOUT and USAID SQALE implementation research programmes in three counties (Kitui, Migori, Nairobi) from 2016-2019 (21,41,215). These QI teams identified and intervened to address locally-relevant quality problems in community health care. The local nature of QI made it impossible to collect data across communities on the same quality problem or health area. Example quality problems from intervention communities in 2018 included[3]:

> *"In Ribakia Community Unit, only 52% of pregnant women completed four ANC visits between 1st April - 30th Sept 2018."* (Nairobi County)
>
> *"In Embakasi West Sub-County, 66% of community health volunteers do not check Mother and Child Booklets during household visits."* (Nairobi County)
>
> *"In Mwingi North Sub-County, 100% of community health extension workers do not submit reporting forms (MOH 515) to the Information Officer by the 5th of every month." (Kitui County)*

[3] Source: USAID SQALE programme data, 2018, unpublished

QI is a health systems strengthening intervention (121,216), intended to improve the quality in whatever health area to which it is applied. So, to estimate the cost-effectiveness we selected ANC to assess the costs and outcomes associated with QI. This was chosen because: 1) maternal health is a policy priority in Kenya; 2) maternal health is a health area covered by community health workers both in and beyond the Kenyan context; 3) ANC and maternal health have been shown to be affected by the QI intervention (42).

5.3. Methods

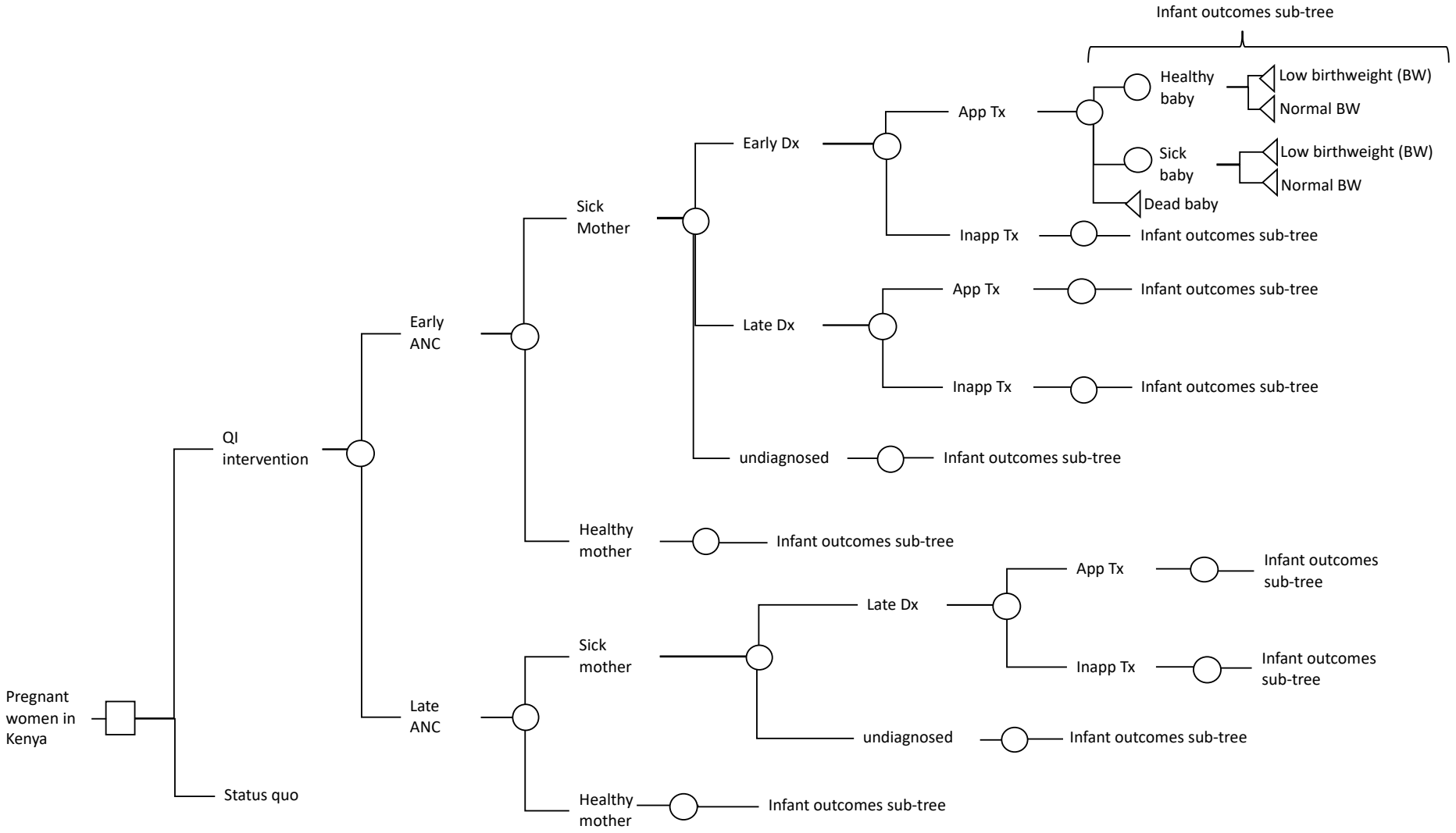
The study is an ex post economic evaluation of the above-described QI capacity development intervention designed to improve quality of healthcare in Kenya's community health system. A de novo decision tree structure was used to assess the cost-effectiveness of a community-level QI capacity development intervention compared to standard community health delivery in Kenya. The study takes a health system perspective on cost-effectiveness and uses a discount rate of 3% on future costs; in line with the Global Burden of Disease study 2010, we do not discount DALYs (217,218). Details of the model structure, costs and effectiveness measures are presented below. We report against the Consolidated Health Economic Evaluation Reporting Standards or CHEERS checklist (219); details in supplementary file 1.

5.3.1. Decision tree model development and structure

We developed a decision tree model of the patient pathway for pregnant women in Kenya, following them along the ANC pathway to delivery. Model development was an iterative process. First, we conducted a scoping review of economic models for ANC with priority given to those from Kenya, followed by sub-Saharan Africa, followed by LMICs more generally (220–222). Second, we developed preliminary structures, on which we sought input and feedback from healthcare professionals (managers, doctors and researchers) working in the Kenyan healthcare system.

Figure 5.1A and 5.1B show the decision tree structures for infants and maternal women, respectively, used in this analysis. Due to the complexity of the tree structures, maternal and infant outcomes were analysed separately. In Figure 5.1A, we assess the impact of early (before 16 weeks) ANC initiation on outcomes related to maternal HIV, anaemia and syphilis infection (i.e. 'sick mother') on congenital infections, low birthweight and infant mortality.

The same tree structure is replicated for the standard of care or comparator arm of the decision tree (not shown). In Figure 5.1B, we examine the impact of skilled birth attendance on maternal mortality with and without the QI intervention. Data for the likelihood of each outcome at the chance nodes is shown in Table 5.1.


Infant outcomes sub-tree
Healthy baby
Low birthweight (BW)
Normal BW
Sick baby
Low birthweight (BW)
Normal BW
Dead baby
App Tx
Early Dx
Sick Mother
Inapp Tx
Infant outcomes sub-tree
App Tx
Infant outcomes sub-tree
Late Dx
Inapp Tx
Infant outcomes sub-tree
undiagnosed
Infant outcomes sub-tree
Early ANC
QI intervention
Healthy mother
Infant outcomes sub-tree
App Tx
Infant outcomes sub-tree
Late Dx
Sick mother
Inapp Tx
Infant outcomes sub-tree
undiagnosed
Infant outcomes sub-tree
Late ANC
Pregnant women in Kenya
Healthy mother
Infant outcomes sub-tree
Status quo

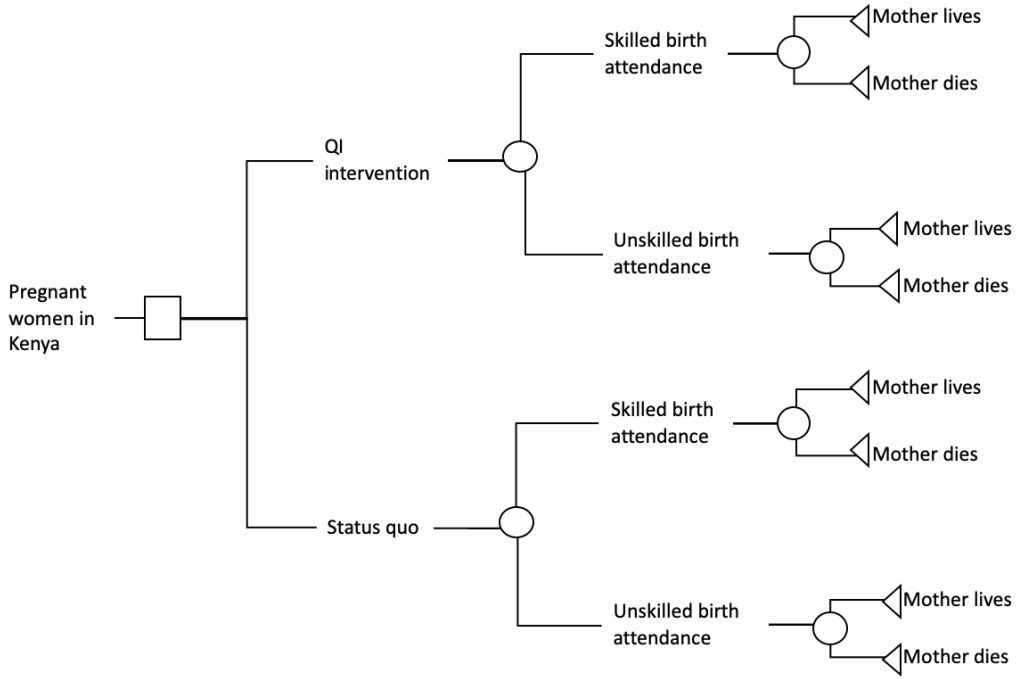


Figure 5.1: Decision tree model schematics for antenatal care influenced by community health workers in Kenya

Figure 5.1A, top, shows a schematic intervention arm of the decision tree for the infant outcomes; the same tree is repeated for the status quo arm in the decision model. Here, 'sick mother' refers to mothers with HIV, syphilis or anaemia. 'Sick baby' refers to either low birthweight, congenital syphilis, or HIV-infected+ infant outcomes; these are each delineated separately in the model. Figure 5.1B, below, shows a schematic of the decision tree for the maternal outcome of interest.

5.3.2. Evaluating costs

Costs of the QI capacity development intervention were collected in 2017 using an ingredients costing approach with a health systems perspective. Resource use information was valued in 2017 prices and annualised, with detailed results published in Kumar et al. (43). We used the annualised economic costs for Kenya presented in this publication, assuming that the costs of a generic QI intervention at community level (as published) are a good representation of the costs of the same community QI intervention where all QI select ANC as their local QI problem. As this is a health system strengthening intervention, the cost is linked to the number of geographic or administrative areas (here, we use sub-county as the intervention unit) rather than the number of pregnant women or patients affected.

5.3.3. Evaluating effectiveness

We used the following primary health outcomes of interest in the model: maternal death, stillbirth/neonatal death, low birthweight, mother-to-child transmission of HIV, and congenital syphilis. These were selected because they can be influenced by early diagnosis and treatment if the first ANC visit is before 16 weeks (223–226) and by skilled birth attendance (227,228), both of which have been shown to be improved by community QI in the USAID SQALE study in Migori, Kenya (42). Secondary (policy) outcomes of interest were: early first ANC visit in first trimester and skilled birth attendance (SBA). DALY weights were obtained from the most recent Global Burden of Disease (GBD) study (229). We assumed the following: clinical independence of the diseases tested for (i.e. no comorbidity); perfect accuracy of diagnostics; no change in the clinical quality of care at health facility level (i.e. ANC visit quality) due to the community-level quality intervention; and adherence to treatment as prescribed. These assumptions should have similar effect in both intervention and standard of care arms. Expected level of effectiveness post-intervention was derived from observation of QI teams in the field (42), followed by literature from Kenyan studies; the sources of these are noted in Table 5.1.

5.3.4. Evaluating cost-effectiveness

A reference target population of 12,208 pregnant women annually per sub-county were the base for calculating the aggregate effect of the QI intervention.[4] This was then divided by the estimated aggregate cost per sub-county of providing the intervention to give the ICERs, reflecting the QI intervention compared to current practice without community QI. The following incremental cost-effectiveness ratios (ICERs) were calculated as the cost per:

- DALYs averted by the intervention
- Priority policy outcomes of additional pregnant women attending early ANC and additional skilled delivery
- Priority health outcomes of infant death averted and maternal death averted.

In assessing the incremental cost-effectiveness DALYs averted, we use the threshold range for Kenya of $32-519 as suggested by Woods et al. as our benchmark (98). We inflated these from 2013US$ (reported) to 2017US$ to align with primary costing data used (230), selecting the actual US$ values reported (not PPP adjusted) because the actual exchange rate was used in the costing study. The inflated values for the threshold range from $38-621 in 2017 prices; we report against the average of this range, US$329.50 in 2017 prices, for the deterministic analysis and report the results of the probabilistic sensitivity analysis against a range of thresholds using a cost-effectiveness acceptability curve.

5.3.5. Study parameters

The following table of parameters (Table 5.1) represents the data that inform the model described in Figure 5.1. In this Table, we show that each chance node is characterized by a base value or point estimate and a distribution. The hierarchy of selection of values for each parameter was as follows: data from Kenya were included where available (national followed by sub-national); data from countries the East African region were considered second tier; beyond that, sub-Saharan Africa and then global estimates for low- and middle-income

[4] To estimate the population of pregnant women per sub-county annually, we took the average of two values: the first takes the average population of the three costing sub-counties (in Nairobi, densely populated) (43); the second of the values was obtained from national data: the national population from 2019 census divided by the number of sub-counties nationally. Each of these values was then multiplied by the percentage of the Kenyan population that is female and multiplied by the fertility rate (236,250,251).

countries were preferred over country-specific data given the influence of context on outcomes.

5.3.6. Sensitivity analysis

Probabilistic sensitivity analysis was done for costs and outcomes. We conducted a Monte Carlo simulation of 1000 runs for each decision tree and aggregated outcomes across both. The details of values of selected for each parameter in each run are reported in supplementary file 2.

We report against a threshold of US$329.50 per DALY averted, derived as described above, and vary all input parameters within the distributions assigned in Table 5.1. Distributions for each parameter were selected based on the type of parameters and data available from the literature as per recommendations in Briggs et al. (99). In general, for probabilities we used beta distributions and at chance nodes with more than two outcomes, we used Dirichlet distributions. Where data were limited, triangular distributions were assumed; point estimates were used for disability weights. We used a triangular distribution for the costs, considering the results of the base case scenario from Kumar et al. (2019) the most likely value, and the values for active and passive adoption represented maximum and minimum costs respectively; costs are not a strictly stochastic variable as they were directly observed in that study for this specific intervention. The results of the probabilistic sensitivity analysis are presented on an incremental cost-effectiveness plane in the form of a scatterplot for each outcome of interest, as well as a cost-effectiveness acceptability curve of the percentage of runs that are cost-effective for DALYs averted under the intervention compared to standard of care.

5.3.7. Clinical Assumptions

Assumptions were made about the clinical conditions to simplify the decision model. It is not clear what effect these assumptions would have on the findings related to cost-effectiveness. However, as clinical or facility-based quality was held constant across the two arms of the study, we expect limited impact of clinical nuance on the findings. These clinical nuances include:

- Available tests have varied sensitivity and specificity in active disease (e.g. the test used in Kenya for syphilis (TPHA) is a measure of whether the individual has ever had syphilis,

not a measure of active disease or intensity of infection): we have assumed perfect sensitivity/specificity

- Role of confirmed diagnosis: individuals testing positive for HIV should receive a second test; in the model, we have assumed one test is given and the result is accurate
- Interactions between diseases may be non-trivial: there is increased vulnerability/risk of comorbidities with certain conditions; we have assumed probabilities of infection with each are independent, and treatment selection may vary by comorbidity (we have used data on the first-line treatment rates for uncomplicated single infections).
- Prematurity does overlap with low birthweight; as such, in the model we have not considered gestational age as an outcome given this violation of independence. Association of prematurity with different diseases considered in the model is less clear but we recognize this as an important infant outcome that also influences mortality.
- We do not look at when babies are found HIV positive; this is usually confirmed clinically through diagnosis at six weeks, but we have assumed that it would be known from birth for simplicity.

5.3.8. Patient and public involvement

Patients and public were not directly involved in the research question development or analysis. However, the research questions were informed by evidentiary needs of sub-national health system managers involved in investment decisions for community and other health programmes expressed as part of the intervention. One of those is a co-author on this paper (EM).

Table 5.1: Main model parameters (42,43,238–247,229,248,249,231–237)

Parameter name	Base case value	Base case location	Source for values*	PSA Distribution	PSA Parameters**	Other notes***
Costs						
Cost of implementing quality improvement for community health in one Kenyan sub-county	$ 29,919.47	Nairobi and Kitui, Kenya	Kumar et al., 2019	Triangular	Low $27468.06, most likely $29,919.47, high $33,290.52	Primary data collected from this intervention in three sub-counties (2017USD); base case used as most likely value and cases of passive/active adoption used for low/high values
Care-seeking behaviour						
Seeks ANC <16 weeks	0.442	Migori, Kenya	USAID SQALE household survey, 2019	Beta	Mean 0.442, SD 0.024	These data were collected pre-intervention and after one year in nine community units served by community and sub-county QI teams in Migori County Kenya and compared to matched control units in the same County.
Seeks ANC <16 weeks (post-intervention)	0.458	Migori, Kenya	USAID SQALE household survey, 2019	Beta	Mean 0.458, SD 0.036	
Skilled birth attendance (SBA)	0.803	Migori, Kenya	USAID SQALE household survey, 2019	Beta	Mean 0.803, SD 0.020	
SBA (post-intervention)	0.921	Migori, Kenya	USAID SQALE household survey, 2019	Beta	Mean 0.921, SD 0.015	
Disease incidence, diagnosis and treatment						
Probability of syphilis +	0.0325	East Africa	Hussen et al., 2019	Beta	Mean 0.0325, SD 0.0051	
Probability of anaemic moderate or more severe	0.118	Kisumu, Kenya	Ouma et al, 2007	Beta	Mean 0.118, SD 0.005	Mild anaemia has limited impact on infant health outcomes so was excluded; SD is estimated

Parameter name	Base case value	Base case location	Source for values*	PSA Distribution	PSA Parameters**	Other notes***
Probability of HIV+	0.012	Kenya	AIDS Indicator Survey, 2012 (pub. 2014)	Beta	Mean 0.012, SD 0.0041	National incident cases
Probability of receiving syphilis test	0.9	Siaya, Kenya	Barsosio, personal communication, 2019	Beta	Mean 0.9, SD 0.03	Estimate; Kenya is now procuring dual HIV-syphilis point-of-care tests so availability is high but not as high as HIV
Probability of receiving anaemia test	0.259	Siaya, Kenya	Young et al., 2018	Beta	Mean 0.259; SD 0.298	
Probability of receiving HIV test	0.99	Siaya, Kenya	Young et al., 2018	N/A	N/A	Because probability approaches 1, this is not included in the model
Probability that syphilis positive receive appropriate treatment	0.706	Siaya, Kenya	Young et al., 2018	Beta	Mean 0.706; SD 0.0188	
Probability that anaemic receive appropriate treatment	0.9	Siaya, Kenya	Young et al., 2018	Beta	Mean 0.9; SD 0.056	
Probability that HIV positive receive ARVs	0.483	Siaya, Kenya	Young et al., 2018	Beta	Mean 0.483, SD 0.0269	
Outcomes						
with maternal HIV						
Probability of infant death, HIV+ mother (untreated)	0.04843	global systematic review	Wedi et al., 2016	Dirichlet	(4.8; 15.9; 29.3)	
Probability of HIV+ infant, HIV+ mother (untreated)	0.159	Kenya	Pricilla et al., 2018			
Probability of HIV- infant, HIV+ mother (untreated)	0.79257					Remainder of the sub-group that is not dead or HIV+
Probability of infant death, HIV+ mother (early treatment)	0.029	Kenya	Kenya DHS, 2014 (pub. 2015)	Dirichlet	(2.9; 2.2; 94.9)	Equal to infant mortality rate in general population

Parameter name	Base case value	Base case location	Source for values*	PSA Distribution	PSA Parameters**	Other notes***
Probability of HIV+ infant, HIV+ mother (early treatment)	0.022	Kenya	Pricilla et al., 2018			
Probability of HIV- infant, HIV+ mother (early treatment)	0.949					Remainder of the sub-group that is not dead or HIV+
Probability of infant death, HIV+ mother (late treatment)	0.25725	Average of early and treatment untreated		Dirichlet	(25.7; 4; 70.3)	Average of early and treatment untreated
Probability of HIV+ infant, HIV+ mother (late treatment)	0.04	Kenya	Pricilla et al., 2018			
Probability of HIV- infant, HIV+ mother (late treatment)	0.70275					Remainder of the sub-group that is not dead or HIV+
Probability of LBW infant, HIV+ mother (untreated)	0.1296	global systematic review	Wedi et al., 2016	Triangular	Low 0.1128, most likely 0.1296, high 0.1488	
Probability of LBW in HIV exposed uninfected infants	0.08	Kenya	Project Concern International, 2017	Beta	Mean 0.08, SD 0.01	Dara et al., 2019 shows difference in mean birthweight between exposed and unexposed but no difference in percentage of that population low birthweight, so we used probability of LBW in healthy mother
Probability LBW in HIV infected infant	0.1296			Triangular	Low 0.1128, most likely 0.1296, high 0.1488	Assumed equal to probability of LBW infant in HIV+ mother (untreated)
With maternal anaemia						
Probability of infant death, anaemic mother (untreated)	0.0899	Tanzania	Marchant et al., 2004	Dirichlet	(9; 15; 76)	

Parameter name	Base case value	Base case location	Source for values*	PSA Distribution	PSA Parameters**	Other notes***
Probability of LBW, anaemic mother (untreated)	0.15	Hungary	Banhidy et al., 2011			
Probability of healthy baby, anaemic mother (untreated)	0.760					Remainder of the population that are not dead or low birthweight
Probability of infant death, anaemic mother (early treatment)	0.072819	global systematic review	Haider et al., 2013	Dirichlet	(7.3; 10.7; 82)	
Probability of LBW, anaemic mother (early treatment)	0.107	Hungary	Banhidy et al., 2011			
Probability of healthy baby, anaemic mother (early treatment)	0.820					Remainder of the population that are not dead or low birthweight
Probability of infant death, anaemic mother (late treatment)	0.0814	Average of early and untreated		Dirichlet	(8.1; 12.9; 79)	Average of early and untreated
Probability of LBW, anaemic mother (late treatment)	0.1285	Average of early and untreated				Average of early and untreated
Probability of healthy baby, anaemic mother (late treatment)	0.790					Remainder of the population that are not dead or low birthweight
with maternal syphilis						
Probability of infant death, syphilis+ mother (untreated)	0.256	sub-Saharan Africa	Gomez et al., 2013	Dirichlet	(25.6; 15.5; 58.9)	
Probability of congenital syphilis, syphilis+ mother (untreated)	0.155	sub-Saharan Africa	Gomez et al., 2013			
Probability of no congenital syphilis, syphilis+ mother (untreated)	0.589					Remainder of the sub-group that are not dead or have congenital syphilis

Parameter name	Base case value	Base case location	Source for values*	PSA Distribution	PSA Parameters**	Other notes***
Probability of infant death, syphilis+ mother (early treatment)	0.046	sub-Saharan Africa	Kuznik et al., 2015	Dirichlet	(4.6; 0.5; 94.9)	
Probability of congenital syphilis, syphilis+ mother (early treatment)	0.005	sub-Saharan Africa	Kuznik et al., 2015			
Probability of no congenital syphilis, syphilis+ mother (early treatment)	0.949					Remainder of the sub-group that are not dead or have congenital syphilis
Probability of infant death, syphilis+ mother (late treatment)	0.151	Average of early and treatment untreated		Dirichlet	(15.1; 8; 76.9)	Average of early and untreated
Probability of congenital syphilis, syphilis+ mother (late treatment)	0.080	Average of early and treatment untreated				Average of early and untreated
Probability of no congenital syphilis, syphilis+ mother (late treatment)	0.769					Remainder of the sub-group that are not dead or have congenital syphilis
Probability of LBW, syphilis+ mother (untreated)	0.121	sub-Saharan Africa	Gomez et al., 2013	Beta	Mean 0.121, SD 0.0001	
Probability of LBW if infant has congenital syphilis	0.193	Global	Korenromp et al., 2019	Beta	Mean 0.193, SD 0.01	Number of LBW divided by the clinical cases of congenital syphilis (subtracting stillbirth and early fetal death); SD assumed same as in healthy mothers
Probability LBW if infant is not syphilis+ and mother is syphilis+	0.08	Kenya	Project Concern International, 2017	Beta	Mean 0.08, SD 0.01	Estimated same as probability of LBW in healthy mothers
with healthy mother						

Parameter name	Base case value	Base case location	Source for values*	PSA Distribution	PSA Parameters**	Other notes***
Probability of infant death, healthy mother	0.029	Kenya	Kenya DHS, 2014 (pub. 2015)	Triangular	Low 0.022, most likely 0.029, high 0.037	
Probability of LBW, healthy mother	0.08	Kenya	Project Concern International, 2017	Beta	Mean 0.08, SD 0.01	Only mean population value given, SD is estimated
with LBW baby						
Neonatal mortality rate (death in month 1) if LBW	0.041	Kenya	Kenya DHS, 2014 (pub. 2015)	Point estimate	N/A	Large sample size of the target population from target country
Length of duration, LBW disability	0.0329	Mozambique	Sicuri et al., 2011	Uniform	2 - 21 days	Acute complications usually resolve within three weeks (or result in death)
maternal mortality						
Probability of maternal death, SBA	0.001	Kenya, Bangladesh	Kenya DHS, 2014; Fauveau et al. 1991			Uses relative risk of mortality in observational study applied to Kenyan maternal mortality rate; Difference between 0.00326 (Kenyan maternal mortality) and probability of maternal death without SBA under the selected distribution
Probability of maternal death, no SBA	0.0026	Kenya, Bangladesh	Kenya DHS, 2014; Fauveau et al. 1991			Same as above
Life Expectancy						
Life expectancy at birth, healthy	66.65	Kenya	WHO life tables	Point estimate	N/A	
Life expectancy at birth, LBW	57.96	sub-Saharan Africa	Fernandes et al., 2015	Triangular	Low 52.91, High 64.8	
Life expectancy at birth, HIV+	28.8	Africa	Ciaranello et al., 2015	Point estimate	N/A	
Disability weights						
Low birthweight	0.291	Global	Global Burden of Disease, 2017	Point estimate	N/A	

Parameter name	Base case value	Base case location	Source for values*	PSA Distribution	PSA Parameters**	Other notes***
			(Kyu et al., 2018)			
Congenital syphilis	0.315	Global	Global Burden of Disease, 2017 (Kyu et al., 2018)	Point estimate	N/A	
HIV+ (at birth)	0.123	Global	Global Burden of Disease, 2017 (Kyu et al., 2018)	Point estimate	N/A	

* If more than one reference is given, the final value represents a summary value

**For beta distributions, we have described these using mean and standard deviation for ease of understanding for the non-economist reader. These were converted to alpha and beta parametrization using the following formulae:

$\alpha = (((\mu\text{^}2\ ) * (1-\mu))/((\sigma\text{^}2\ ) - \mu)\ ))$

$\beta = \left((1-\mu) * \left((1-\mu) * \mu\right)/(\sigma^2 - 1)\right)$

***For disability weights, the equivalent category in the Global Burden of Disease Study 2017, which was used for the disability weight of each of these health states, is described. Where comorbidity was observed, the deterministic model used the cumulative value of the two health states for the duration of comorbidity and reverted to the disability weight of the single persistent health state for the remaining duration. A uniform distribution ranging from the higher of the two single disability weights to the deterministic cumulative weight was used in the probabilistic sensitivity analysis

5.4. Results

5.4.1. Incremental costs and outcomes

We calculated incremental cost-effectiveness ratios (ICERs) between current community health care and the QI intervention, which was defined as (cost of QI intervention / (effectiveness of QI intervention – effectiveness current standard of care)). The results of this deterministic analysis for different outcomes of interest are shown in Table 5.2.

Table 5.2: Deterministic predictions of incremental health impact and incremental cost-effectiveness of QI for community health systems intervention (236,250,251)

Incremental cost (2017USD) per	
DALY averted	$ 249.43
Clinical outcomes:	
Infant death averted	$ 37,535.78
Maternal death averted	$ 5,654.19
Policy targets:	
Skilled birth	$ 9.58
Early ANC initiation	$ 154.69
Annual number of	**At national scale***
DALYs averted	13,930
Infant deaths averted	93
Maternal deaths averted	272
Skilled births	160,636
Early ANC initiations	22,462

*Based on estimated 1,361,326 pregnancies in Kenya per year (estimate from 2019 census data and DHS birthrate data)

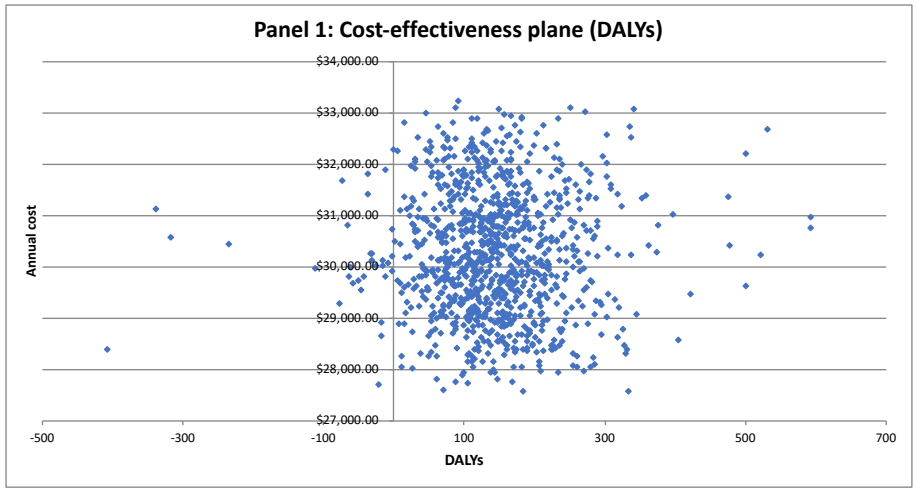
Specifically, we show that the intervention is cost-effective under the threshold selected, at an incremental cost of US$249.43 per DALY averted. These DALYs are drawn cumulatively from the morbidity and mortality impacts of early detection and treatment of HIV, anaemia and syphilis in ANC visits and on maternal mortality

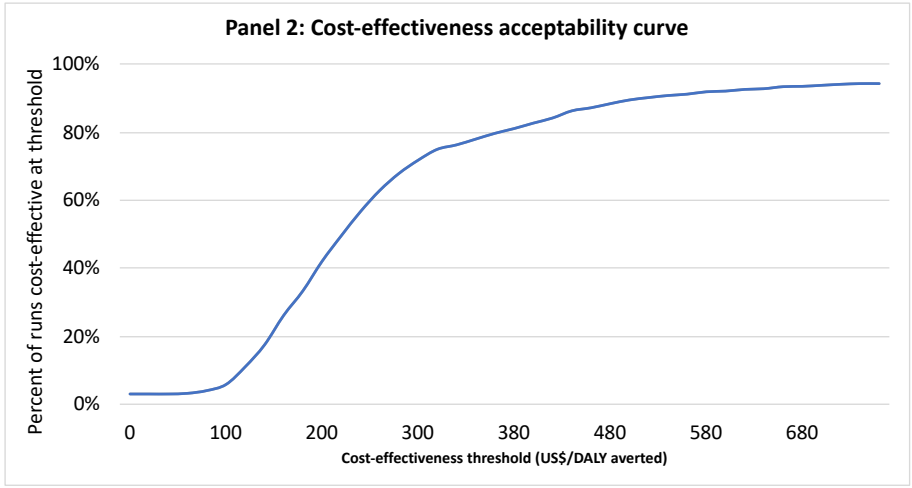
averted due to increased skilled birth attendance. Additions to both policy outcomes (skilled birth and early ANC initiation) are achieved very low incremental cost, at $9.58 and $154.69 respectively.

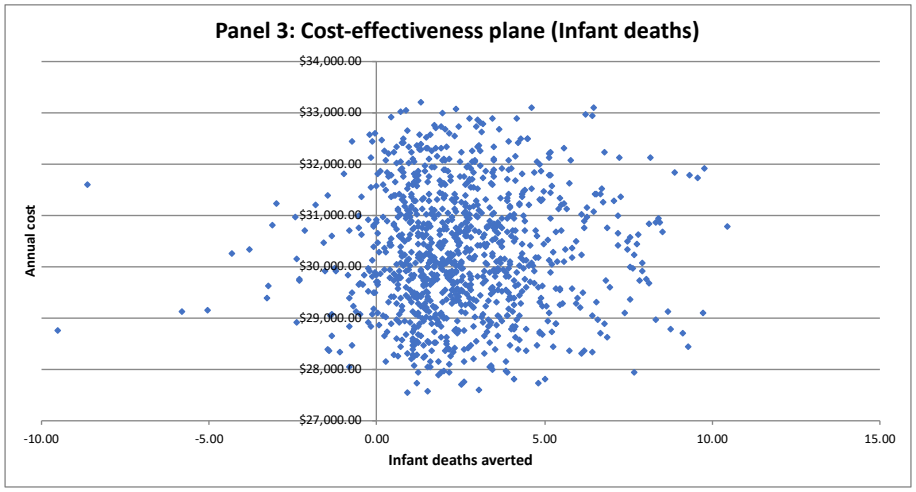
If taken to a national scale, at the current efficacy, we estimate that the intervention would avert over 13,000 DALYs each year of implementation and would increase the annual number of skilled births by over 160,000 in Kenya, averting 93 infant deaths and 272 maternal deaths annually.

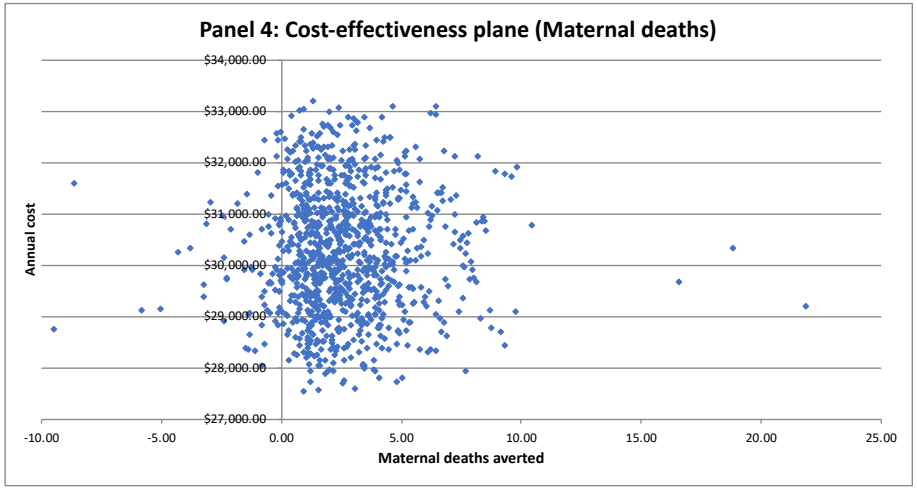
5.4.2. Characterising uncertainty

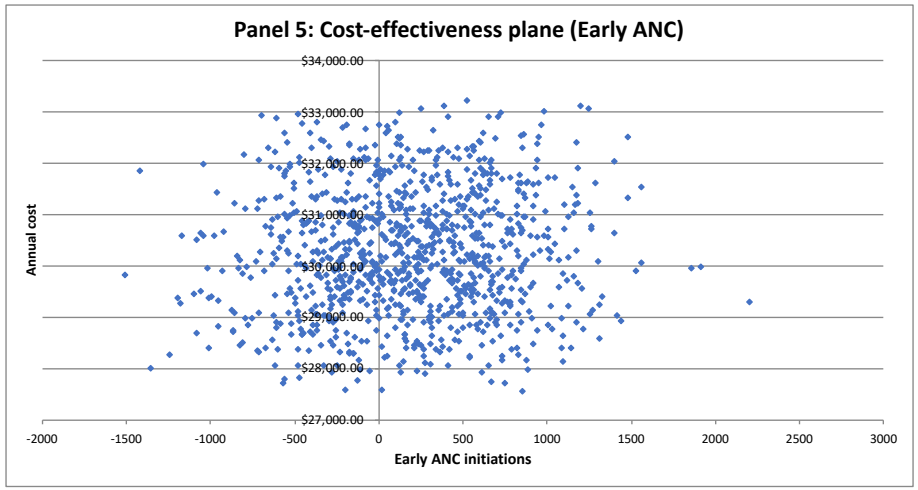
Results of the one-way sensitivity analysis around the two key intervention parameters and the costs are shown in a tornado diagram (Supplementary Material 3). This shows highest sensitivity to cost but all ICERS are cost-effective, falling between US$242-267 per DALY. In the probabilistic analysis, we found 76.4% of the 1000 runs under the average of the threshold range values (3.2% of the simulations fell in the northwest quadrant, showing the intervention as more expensive and less effective than standard of care in terms of DALYs averted were cases where the impact was negative). 23.6% of the cases exceeded the threshold average. Under the least strict threshold or high end of the threshold range (US$621), 93% were cost-effective; under the strictest threshold or low end of the range (US$38), none were cost-effective, as shown in cost-effectiveness acceptability curve for incremental cost per DALY averted at the different thresholds in Panel 2 of Figure 5.2.


Panel 1: Cost-effectiveness plane (DALYs)
$34,000.00
$33,000.00
$32,000.00
$31,000.00
$30,000.00
$29,000.00
$28,000.00
$27,000.00
Annual cost
-500
-300
-100
100
300
500
700
DALYs


Panel 2: Cost-effectiveness acceptability curve
100%
80%
60%
40%
20%
0%
Percent of runs cost-effective at threshold
0
100
200
300
380
480
580
680
Cost-effectiveness threshold (US$/DALY averted)


Panel 3: Cost-effectiveness plane (Infant deaths)
$34,000.00
$33,000.00
$32,000.00
$31,000.00
$30,000.00
$29,000.00
$28,000.00
$27,000.00
Annual cost
-10.00
-5.00
0.00
5.00
10.00
15.00
Infant deaths averted


Panel 4: Cost-effectiveness plane (Maternal deaths)
$34,000.00
$33,000.00
$32,000.00
$31,000.00
$30,000.00
$29,000.00
$28,000.00
$27,000.00
Annual cost
-10.00
-5.00
0.00
5.00
10.00
15.00
20.00
25.00
Maternal deaths averted



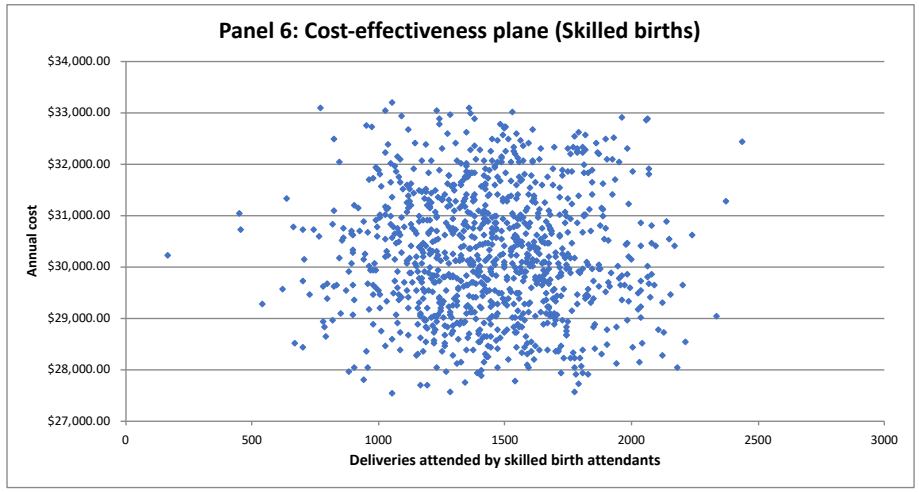


Figure 5.2: Cost-effectiveness planes for outcomes of interest

5.5. Discussion

Our model has shown that QI for community health is cost-effective. The benefits of QI as a health system strengthening intervention can be examined through the lens of different clinical conditions; here we have selected maternal health as both a national priority and target of community health worker efforts. There are quantifiable benefits of community QI on policy priorities of increasing skilled birth attendance and early ANC initiation, and these are the drivers of the impact in this decision tree model. The model shows the cost per DALY averted to be $249.43 and cost-effectiveness in over 75% of cases per the cost-effectiveness threshold selected.

5.5.1. Economic evaluation of complex service delivery interventions

A conceptual framework for the causal pathway showing how community QI strengthens the health system to yield downstream benefits is shown in Figure 5.3. This places the QI cycle at the centre of the structures, process and decisions that underpin the functioning health system, in which community health plays an integral role. Examination of this causal pathway illustrates clearly why a full economic evaluation of community-level QI is challenging: it is a complex intervention and is operating in a complex system (62,123,252,253). Complex interventions elicit three specific challenges for cost-effectiveness analysis: diverse or heterogenous outcomes; complex and indirect links between intervention and desired outcomes; and violation of the assumption that the outcomes of the intervention can be isolated from the healthcare system context (99). Figure 5.3 shows the non-linear causal links between intervention and intended outcomes; impacts at multiple levels in the healthcare system, on multiple stakeholders and across multiple health areas; and the high degree of flexibility in the intervention through selection of QI problems as a behavioural or service delivery intervention (90,254,255).

In considering the impact of community QI on health outcomes in Figure 5.3, it is clear any change elicited at the community level is mediated by the quality of care obtained in primary care facilities (held constant in the two arms of the decision tree). Health systems managers in LMICs more commonly implement facility-level QI, and this has been shown in many locations in the region to yield positive effects in

maternal and newborn healthcare outcomes like those evaluated here (115,256–258). However, without community involvement, facility QI alone is unlikely to identify or reach pregnant women early. In future implementation of QI at the level of primary healthcare, we would propose implementing through a joint community-facility QI team to collaborate at different points in the continuum of care. That linked or primary healthcare model of QI would likely yield greater benefits and therefore increase cost-effectiveness. It is only when such linkages and continuum of care can be created and sustained in the system that referrals can function optimally, integration between vertical programmes can be achieved, national policy revised, and systems sustained - ensuring real progress towards UHC.

5.5.2. Underinvesting in community health programmes and quality of care

Community QI as an investment for potential intervention suffers in comparison to other possible investments by being community level and by being a health system strengthening intervention. The focus on a curative approach to healthcare in many health systems leads to underinvestment in community health programmes generally. In their systematic review of cost-effectiveness of community interventions for child health outcomes, Nkonki et al. find all interventions cost-effective or highly cost-effective (77). An additional barrier to investment in community health is that it is a service delivery platform – it is easy to conceptualise of buying more chemotherapy drugs for a hospital, but less immediate to invest in capacity building or quality improvement. This is especially true for those investment decision makers who are subject to electability considerations and may prioritise 'visible' hardware investments in infrastructure instead of health system strengthening interventions (139,259). The global community health research and implementation community have tried to overcome this with a series of investment cases at global and national level, e.g. (87,104,260), yet recent research by Lu et al. suggests that this has not been successful in increasing financing for community health (107).

As briefly mentioned in the introduction, quality of care is similarly undervalued as a health system strengthening intervention. In 2018, three major reports on quality were published that made this issue more visible (44–46), welcome progress for health system strengthening, yet community health was not included in a meaningful

way (47). The prioritisation of outcomes in any economic evaluation incorporates assumptions about the decisionmaker and their values; in this case, both national and county decisionmakers have focused on quality of maternal and newborn care to reduce mortality as a priority health indicator for change. The policy outcomes examined in this analysis are evidently valued by decisionmakers, given their prominence in the Kenyan national strategy for focused ANC and county targets for reaching four ANC visits that are monitored through the health management information system though these have not yet been updated to align with the WHO recommendations for eight visits (261). They are also not independent – for example, if a pregnant woman makes her first ANC visit early in pregnancy, she is more likely to have time to come for four visits. If she is given the full set of recommended tests and screening (or ANC profile) at the first visit, she may be impressed by quality and more likely to come back. Good quality ANC visits include counselling for SBA, so more ANC visits is likely to correlate with SBA (262).

Given that community QI is cost-effective, in order to improve the chances of investment, more need to be investigated about the decision makers at global, national, and sub-national levels. By elucidating their priorities for evidence, and the likely structures or mechanisms for using it, evidence uptake can be improved.

5.5.3. Generalisability

There are three factors that influence the generalisability of the study: the selection of the QI priority issue (ANC) vis-à-vis responsibilities of CHWs; the geography selected (Kenya); and the availability of nationally-representative data (selection of values for each parameter, especially where non-Kenyan sites are included, may influence the results of the analysis).

The selection of ANC as a representative health area from which to assess the cost-effectiveness of QI was done for two reasons: first, CHWs in almost all countries deal with maternal health and conduct health promotion with pregnant women (usually among other tasks); second, it is a policy priority at multiple levels in the Kenyan health system and so has greater likelihood of being selected as the priority problem by QI teams in the study setting in the future implementations. This speaks to both

generalisability as well as relevance in the study site and the impact is described above.

The intervention effectiveness data on increased in early ANC attendance and SBA came from Migori County and was measured through Lot Quality Assurance Sampling; thus, we have reasonable confidence that the study data represent Migori County. In Migori, there are lower than national average rates of early ANC. Poor performance on health indicators are counterbalanced by strong leadership and a positive funding environment for maternal and community health. In selection of parameter data for the other incidence and outcome parameters, we have prioritised nationally-representative data and therefore suggest that these findings could be generalisable to Kenya nationally. By selecting of maternal and newborn health as the priority area for which to assess benefits, as described further in the next section, this helps make the case for generalisability beyond Kenya. Rates of SBA and early ANC are lower in many countries than at baseline in Migori County, so we would expect that the model may underestimate potential benefits of the intervention in other contexts.

5.5.4. Goodness of fit of the model: heterogeneity and limitations

For most of the parameters, we were able to identify either primary or secondary sources from Kenyan or East African populations, raising confidence in the model fit. Some uncertainty related to heterogeneity remains including:

- Variations in implementation of the community strategy in different counties (formation/coverage and functionality of community units; ratio of community health workers to population)
- Regional variation in burden of disease (particularly relevant for malaria, anaemia)
- Equity of access to healthcare (includes distance to facility as well as socioeconomic household characteristics, ethnicity)
- Individual behaviours and care-seeking choices (experiences with the healthcare system, home circumstances, parity, age, education)

However, community health is intended to overcome some barriers to access to healthcare and we have used the recommendations from national

policies/approaches where possible. As county governments are the healthcare fund holders in Kenya, a county-level analysis would be recommended to define specific funding requirements and should include more granular detail on policies, disease and population.

We have likely underestimated the cost-effectiveness of community QI because the approach we have taken underestimates the benefits in two ways. The first is through limiting the measurement of benefits of this health system strengthening intervention to a single technical area, maternal health. We cannot assume what QI problem a team will select; indeed, we expect them to address different problems over time as their capacity is built in these transferable skills and they work iteratively through the PDSA cycles. By selecting just one condition or health area for which to measure outcomes, we are purposefully under-estimating the benefits of a QI approach at community level. Having shown these benefits are sufficient to justify investment (i.e. meet the threshold), then a full quantification of all the benefits across health areas is unnecessary. The second reason for underestimation is caused by the impact data that drives the economic model from the Migori implementation of community QI (42). There is one parameter in each tree that drives the cost-effectiveness. In the infant outcomes tree, Figure 5.1A, this is the rate of early ANC initiation. In the maternal outcomes tree, Figure 5.1B, this is the rate of skilled delivery. However, these indicators were not the target of the QI teams' interventions in those sites – they were simply related policy priority areas that showed improvement after the intervention.

In the intervention study, routine indicators tracked by QI teams could be categorized in four areas: child health (growth monitoring, nutrition), maternal health, and data quality/referral (41). We expect that if a team were to focus on a given indicator as its QI problem, the rate of increase would be greater than what is observed coincidentally in these cases. When we examine the DALYs yielded by the model, 79% of the DALYs are yielded from the maternal tree. The one-way sensitivity analysis shows that there is limited sensitivity to these variables within the extremes of the measured range (Supplementary Material 3). The magnitude of benefits (and even the beneficiaries) obtained by targeting the different routine indicators would vary, and this could in turn influence the assessment of whether the intervention is

cost-effective. We would expect that, for example, given the number of children under five is much greater than the number of pregnant women, interventions around nutrition and growth monitoring would be more likely to yield significant benefits (though they require behaviour change by the adult caregiver as well). Interventions around processes (such as referral, reporting and data) are likely to be more challenging to link to health benefits, but may yield significant increases in policy-relevant and -valued outcomes, such as high-quality community-level data.

5.6. Conclusions

In conclusion, this health system strengthening intervention to build capacity in community QI was shown to be cost-effective with impacts drawn from one health area, ANC. The putative impact of QI for primary healthcare could be increased through additional leadership and coordination between teams at community and facility levels, improving referral, treatment and adherence.

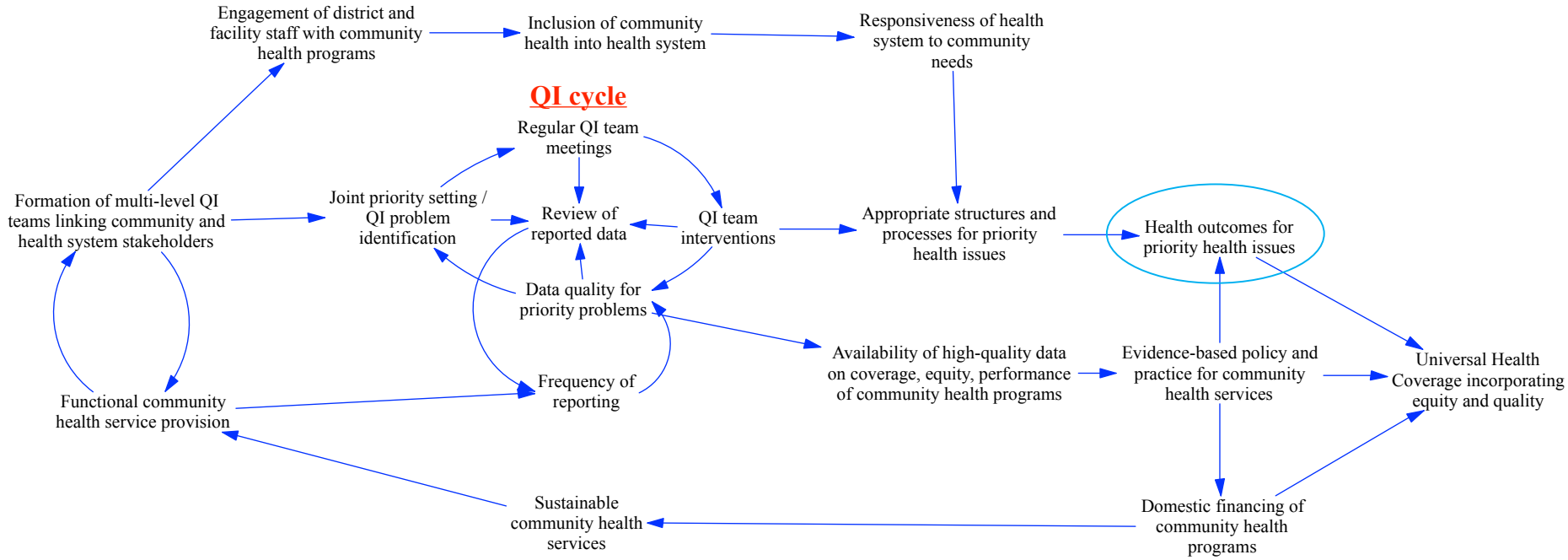


Figure 5.3: Conceptual framework / system map of plausible impact of community QI on priority health areas

6. How do decision makers use evidence in community health policy and financing decisions? A multi-country qualitative study and conceptual framework in four African countries

This chapter is the third in a series of three results manuscripts and has been submitted for publication in Health Policy and Planning. Reviewers' comments have been received and responded to in January 2020. The paper follows the line of questioning elicited in the discussion in Chapter 5 regarding the use and usefulness of economic evaluation data in community health decision making. I took a qualitative approach and focused on the four sub-Saharan African settings, to avoid the potential regional variation between East/Southern African and the Asian contexts included in the wider REACHOUT consortium.

Because of the complexity of decision making in an environment that encompasses multiple decisions and multiple levels of actors in the health system, I ask questions about the use of all types of evidence in decision making generally and explore experiences and perspectives on quality of care and QI in community health systems. In the interest of generating evidence about sustainability, I use QI as a case example to understand the decision process to sustain project-style interventions beyond funding periods and in routine workflows. The conclusions about improving evidence value and use in decision making for QI in community health are then further developed in the thesis discussion, Chapter 7. Supplementary materials submitted with this manuscript are found in Appendix 10.

Title: How do decision makers use evidence in community health policy and financing decisions? A multi-country qualitative study and conceptual framework in four African countries

Corresponding author:

Meghan Bruce Kumar, MSc

Address: Pembroke Place, Liverpool L3 5QA UK

Tel: +254 733440052

Email: Meghan.brucekumar@lstmed.ac.uk

Author affiliations and qualifications:

Meghan Bruce Kumar, MSc

1 Community Health Systems Group, Department of International Public Health, Liverpool School of Tropical Medicine

2 Center for Humanitarian Emergencies, Rollins School of Public Health, Emory University

Miriam Taegtmeyer, BM BCh (Oxon) FRCP PhD

Miriam.taegtmeyer@lstmed.ac.uk

1 Community Health Systems Group, Dept of International Public Health, Liverpool School of Tropical Medicine, Liverpool UK

3 Tropical Infectious Disease Unit, Royal Liverpool University Hospital, Liverpool UK

Jason Madan, PhD MSc

j.j.madan@warwick.ac.uk

4 Centre for Health Economics at Warwick, Warwick Medical School, University of Warwick, Coventry UK

Sozinho Ndima

sozinhondima@gmail.com

5 Community Health Department, Faculty of Medicine, University Eduardo Mondlane, Maputo Mozambique

Kingsley Chikaphupha

kchikaphupha@gmail.com

6 Research for Equity and Community Health (REACH) Trust, Lilongwe, Malawi

Aschenaki Kea

aschenakizer@yahoo.com

7 School of Public and Environmental Health, Hawassa University, Hawassa, Ethiopia

8 Center for International Health, University of Bergen, Norway

Edwine Barasa, PhD MSc

EBarasa@kemri-wellcome.org

9 Health Economics Research Unit, KEMRI-Wellcome Trust, Nairobi, Kenya

10 Centre for Tropical Medicine, Nuffield Department of Clinical Medicine, University of Oxford, Oxford, UK

Author contributions:

Study design and measures: MBK, MT

Ethical approval and data collection: MBK, SN, KC, AK

Data analysis, interpretation of results: MBK, MT

Drafting of manuscript: all

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Health Financing

Ethiopia

Kenya

Malawi

Mozambique

Abbreviated/running title:

Evidence use in LMIC community health decisions

Key messages:

1. The use of evidence in national community health policy and financing decisions is limited by its perceived poor quality and the capacity of decision makers to use it
2. Most existing evidence is perceived as of limited relevance to domestic decision making; it is used more by global financiers of community health.
3. Decision makers emphasise increasing coverage of or access to services community health services – quality is rarely mentioned as a funding priority
4. Stopping an established approach to community health (disinvesting) in favour of another more economically viable approach is seen as politically challenging even when evidence exists.

Ethical approval:

Ethical approval for the global interviews was obtained from the Liverpool School of Tropical Medicine under protocol 17-009. Local approval was also obtained for each study country as detailed in Supplementary File 4. Written informed consent was obtained from all respondents.

Acknowledgements:

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6.1. Abstract

Various investments could help countries deliver on the universal health coverage (UHC) goals set by the global community; community health is a pillar of many national strategies toward UHC. Yet despite resource mobilisation toward this end, little is known about the potential costs and value of these investments, as well as how evidence on the same would be used in related decisions. This qualitative study was conducted to understand the use of evidence in policy and financing decisions for large-scale community health programmes in low- and middle-income countries (LMICs). Through key informant interviews with 43 respondents in countries with community health embedded in national UHC strategies (Ethiopia, Kenya, Malawi, Mozambique) and at global institutions, we investigated evidence use in community health financing and policy decision making, as well as evidentiary needs related to community health data for decision making. We found that evidence use is limited at all levels, in part due to a perceived lack of high-quality, relevant evidence. This perception stems from two main areas: first, desire for local evidence that reflects the context; second, much existing economic evidence does not deal with what decision makers value when it comes to community health systems – that is, coverage and (to a lesser extent) quality. Beyond the evidence gap, there is limited capacity to assess and use the evidence. Elected officials also face political challenges to disinvestment as well as structural obstacles to evidence use, including the outsized influence of donor priorities. Evaluation data must to speak to decision maker interests and constraints more directly, alongside financiers of community health providing explicit guidance and support on the role of evidence use in decision making, empowering national decision makers. Improved data quality, increased relevance of evidence and capacity for evidence use can drive improved efficiency of financing and evidence-based policymaking.

6.2. Introduction

Well-resourced close-to-community (CTC) health workers can deliver high-quality care; there is extensive, robust, project- and trial-based evidence for this across a range of settings and disease areas, as shown in a set of recent reviews of community health programmes (54–56,58,59,66,212). Armed with this evidence, extending access to primary healthcare through CTC cadres with an aim of universal health coverage (UHC) has long been used as an approach and lately become a priority in many countries (263–265). The World Health Organisation has supported operationalisation of extending access in this way through the development of guidelines for national CTC programmes (153). Yet in many health systems, community health remains perceived as an extension of the 'formal' system rather than a core, integrated service delivery platform (62,82,266).

Economic evidence should play a predominant role in the integration of community health into wider health systems, due to the need for trade-offs between different health investments and competition for limited resources. There is a small but growing body of economic evidence on community health programmes, recently presented in a systematic review by Nkonki et al.; like the evidence on quality described above, the authors state that most evidence is "from small scale and vertical programmes" (77). Once community health programmes start operating at scale, quality of care and performance of CTC providers do not always live up to their potential (34,50,75,84,267,268). The limited economic evaluations of the quality of large-scale CTC programmes generates uncertainty about the value of this investment; studies on the costs of large-scale CTC programmes (77,79,88,269,270) have rarely incorporated data on quality of care. In assessing outcomes, incorporating quality into economic evaluations of CTC programmes is challenging because of difficulty in defining quality of care for CTC interventions and the complex causal pathways between CTC quality of care measures and health outcomes. Poor data quality affects measurement across both costs and outcomes (72,75).

As an extension or even marginalised aspect of the healthcare system, community health decision making does not benefit from the many formal procedures for generating and using evidence that have been developed in the wider health sector. For example, there is a gap in community-focused financing literature; Scott et al.

showed that out of 122 publications on the ASHA programme in India between 2005 – 2016, only five dealt with financing (271). Where it exists, community financing literature often focuses more on community-based micro insurance schemes rather than macro financing of community health programmes despite a predominance of external financing in this space (140,272). Because potential users of evidence often perceive community-level care as 'free' to the system, this limits commissioning of economic evidence at local and national levels. Similarly, in the wider sector, the broad literature on proceduralism focuses on formalised processes for evidence use, consultation, transparency (130) – yet in community health as a sub-sector, these processes are not well established. As such, even when evidence about community health interventions is available, this evidence may be underutilised in decision making. In the absence of sufficient procedures, (the largely external) investment in community health seems to be driven by ideology and global movements over evidence. A closer look specifically at community health decisions within the health sector is imperative given the relative marginalisation of community health as an extension of the health system and its reliance on external financing in many LMICs (82,265,266).

This multi-country qualitative study was designed to understand the role of evidence in how decisions are made for community health financing and policy at national and global levels. We focus our study in four countries (Ethiopia, Kenya, Malawi, Mozambique) that have large-scale public sector community health programmes that remain highly dependent on external financing. In key informant interviews with national and global funders, policymakers and researchers, we set out to understand what evidence is used and by whom, and when and what additional evidence could improve the efficiency of community health decision making in settings where CTC providers are an integral part of the health system.

6.3. Methods

We used a qualitative cross-sectional approach to understand the use of economic evaluation evidence in community health priority setting and financing. Qualitative methods were utilised to allow for an understanding of the process (how things are

currently working), stakeholders (who is involved), and wider decision space (role of the health system and context). Given the limited number of individuals involved in policy and financing decisions and their seniority, key informant interviews were selected as the most appropriate methodology to extract relevant information. Data were collected between November 2017 – November 2018.

6.3.1. Study sites and sampling

43 key informant interviews were conducted with purposively sampled decision makers involved in community health policy and financing decisions at national and global level based on the sampling frame shown in Table 6.1. We selected countries with national community health programmes in Africa that were part of the REACHOUT consortium: Kenya, Ethiopia, Malawi, Mozambique[5](21). Respondents included national and sub-national Ministry of Health staff involved with community health financing and/or programming, and implementers of large-scale community health programmes. The global interviews included institutional financiers of community health, community health researchers and normative agencies. These respondents were selected to represent those making community health policy and financing decisions in the selected REACHOUT countries, generating evidence to inform the decisions, and those affected by the decisions through involvement in translating policy to practice.

Table 6.1: Sampling framework

Category	Possible respondents	Location	Eligibility criteria

[5] REACHOUT is a multi-country research consortium focused on the quality of community health that worked from 2014-2019 in six countries (Ethiopia, Kenya, Malawi, Mozambique in Africa; Bangladesh and Indonesia in Asia). For this piece of work, we focused on the African countries. For details on the community health programmes in the four study countries, see Supplementary File 1.

Global funders and policymakers of community health	USAID, Global Fund, UNICEF, WHO, UN Special Envoy, Financing alliance, DfID, Health Systems Global CHW TWG members	Global – Mix of remote and in-person	Funders of cases identified in the literature review
National/sub-national CTC programme decision makers	National Community health unit, National division of standards, district/county community or quality focal point, NGOs (as appropriate)	2-4 per country at relevant levels In-person	Identified by REACHOUT country teams Involved in: policy, financing, and/or programming decisions for CTC providers
Community health researchers and implementers	REACHOUT country Principal Investigator; Domestic academic or NGO-based researchers (international if embedded in a local health system)	2-3 per country In-person	Working on REACHOUT project for three or more years OR Researching CTC providers for 3 or more years

6.3.2. Data collection, management and analysis

Interviews were guided by a semi-structured topic guide, which was piloted in Kenya before use (available in Supplementary File 2). We asked respondents questions about their community health experience; about domestic and external financing for community health in their setting; and, using quality improvement as a case example of a project, about evidence needs, evidence use, and financing mechanisms related to decision making and the (community health) decision space.

In all cases except two in Ethiopia and two in Mozambique, interviews were conducted in English by the corresponding author. In those four interviews, local researchers with prior experience in qualitative methods and community health were trained in the interview content and objectives and conducted the interviews.

Thirty-nine of 43 total interviews were digitally recorded and transcribed by local researchers in each country (where they were conducted in another language, they were transcribed in the local language and then translated); the remaining respondents asked not to be recorded and interviewer notes were included in lieu of a transcript. Code frame development was done deductively according to the objectives of the study: understanding decision maker perspectives on quality and understanding the use of evidence in decision making for community health financing and programming. Additional codes (particularly, detailed information around financing and economic evidence) were added inductively in the course of the analysis as they had arisen due to the open questioning style used in the interviews (273); for full code frame see Supplementary File 3. Analysis was assisted by NVivo11 software and for each theme, relevant quotes were examined to generate a draft narrative. A thematic framework approach was used for the analysis (273). Given there was a single lead researcher conducting interviews and coding, quality assurance was done in the following ways: 1) review of selected transcripts by senior authors; 2) coding workshop with colleagues where multiple individuals coded transcripts to ensure inter-coder reliability; 3) discussions with and feedback from research partners/co-authors in each country on emerging themes. For non-recorded interviews, the notes were included as transcripts and coded in the same way as verbatim transcriptions described above; direct quotes from these interviews were not included due to risk of misrepresentation of exact wording.

6.4. Results

6.4.1. Respondent characteristics

A total of 43 key informant interviews were conducted with purposively sampled respondents working in community health at national and global level. In total, these were: Global (N=11), Ethiopia (N=10), Kenya (N=7), Malawi (N=6) and Mozambique (N=6); descriptions of respondents shown in Table 6.2. There was a focus on policy and financing decision makers, with the latter being over-represented at global level due to the predominance of external financing in this area. Implementers and health workers represent the individuals who translate decisions into practice/action and

have a perception of how and if their evidence gets used in this process. Of the researchers, who represented a smaller proportion of the total sample, two were economists and the majority were working more broadly on implementation research, governance, feasibility and process evaluations in the CTC space.

Institutions represented at the global level included: UNICEF, World Health Organization; Global Fund to Fight AIDS, Tuberculosis and Malaria; Global Financing Facility for Women, Children and Adolescents; Last Mile Health; Financing Alliance for Health; United Nations' Special Envoy for Health; Community Health Impact Coalition; United States Agency for International Development; South Africa Medical Research Council; John Snow International representing Maternal and Child Health Integrated Program; out of this group, implementers are those organisations that deliver community health programmes in country. Institutions represented at country level are national and sub-national government staff as well as NGOs and International Organisations as relevant to the community health planning, financing and delivery in each context.

Table 6.2: Respondent characteristics

Level/Country	Programme policy	Programme financing	Researcher	Implementer/Health worker	Total
Global	1	5	2	3	11
National/Ethiopia	3	1	1	5	10
National/Kenya	3	1	2	3	8
National/Malawi	2	2	1	3	7
National/Mozambique	2	1	1	4	7
Total					**43**

**Respondents were allowed in exceptional cases to be included in more than one category or quota*

6.4.2. Evidence use in national decisions for publicly funded programmes

The reported use of economic evidence in health policy and financing decisions varied by country, but was generally informal and motivated by individuals instead of systems. Ethiopia demonstrated the most formalised processes and procedures for use of economic evaluation in the health sector at the national level, with a separate department inside the Federal Ministry of Health's Planning Directorate responsible for using and assessing economic evidence (particularly finance data from National Health Accounts and evaluation data from Public Health Research Institute). No study countries systematically required the use of economic evidence in decision making for as a formal stage in public policy or financing decisions for community health. Community health systems were, in the views of most respondents, an extension of the health system rather than a core part, evidenced in part by the title of CTC workers as 'extension workers' in some settings. As such, community health was viewed as a lower priority than other health areas in terms of commissioning evidence, and related decision making was less restricted by formalised processes and requirements for evidence. In the absence of these governing structures, change was often described in our data as driven by individual leaders and/or the desire for political advantage instead of evidence, as in this case from Kenya:

> *"I haven't seen anyone talking about an incremental approach [to policy change in community health]; I have just seen the type like Kitui [County] where you [leaders] decide today: 'I'm going to do this and I'm going to put this money'."*
>
> - Community health researcher, Kenya

The most commonly available evidence of impact or benefits of community healthcare investments at national level, understood as programme performance by the majority of respondents, was generated by CTC health workers through routine monitoring and evaluation. However, these routine data were not thought by most to be reliable enough to support decisions; improving the quality of routine CTC data was considered by several respondents to be a prerequisite to its use. This was compounded by the fact that these data are often paper-based (community data are reported in DHIS2 only in Kenya and Ethiopia, and even these are often incomplete),

so the process of obtaining performance data from this source may have prohibitive time cost. A sub-national key informant in Mozambique told us of frustrations in trying to get and use routine community health programme data in their work:

> *"The APE [or CHW] is producing data in a useful way but this information I feel that, I do not know where it is going because I do not have a report of what happens to 'my' information. I get a bit confused because there is no transparency of where [that] information goes. When I consult the Ministry, they say that it is used by the programmes, but we at the level of the province we do not feel that".*
>
> - Policymaker, Mozambique

Few national-level respondents talked about using cost-effectiveness evidence to inform decisions, though in Ethiopia there were several who mentioned aspirations to generate their own cost-effectiveness data for projects and new programmes. The limited number who mentioned them stated that cost-effectiveness studies, where available, are not seen by national policymakers as addressing budget constraints, as they do not address real constraints on available financing. This was summarised by a respondent in the Federal Ministry of Health in Ethiopia as follows:

> *"The results they submitted to us [show] if the implementing second generation is the extension program cost effective? But it needs really further discussion and also policy dialogue also with some stakeholders…it's more expensive… I think we need more data like for example if we implement second generation extension program all over the country how much cost it will take and the other thing what are the health gains in this amount of investment."*

In contrast, several respondents discussed costing data being used alone, both to fundraise and to decide whether to expand coverage of the CTC programme – and the challenges of allocation across many interventions with a limited budget. No respondents directly stated a need for evidence on equity of community health services, despite 'extension' of services being discussed as a means to reach the unreached in all countries. However, coverage was understood to address some (primarily geographical) equity considerations.

6.4.3. Evidence use in funding applications

The influence of external financing and donor priorities on community health decisions came out strongly in the data. In the study countries, external financing is a majority of the community health financing, yet it was seen as unpredictable and (often) having limited flexibility. A financing agency key informant in Kenya described the role of external financing on community health: "…*the disadvantage of being off budget is you are working outside the system. Yeah, it's a parallel system which is unhelpful in many ways and complicates things. That's one of the causes why community health care is funding 'off budget' mainly and by donor funding".* Each donor and their priorities were described as changeable and contingent on other fiscal planning and calendars – yet they put pressure on national government to adapt to and often adopt their priorities. For many national level key informants, the predominance of external financing brought about a lack of motivation and/or space to drive the agenda in their own health sector.

> *"You see like right now say USAID has money and all their money goes to partners…the partners need to implement what USAID and government have agreed on; so theoretically that is what happens but we know mostly it is pushed by USAID and we follow that and because the counties just want the money, they will say: 'it's fine let's go ahead'…"*
>
> - Community health researcher, Kenya

External financing was seen to limit the value of economic evidence to government staff; governments are desensitised to the full costs of these programmes and in some cases view the international priorities as 'pre-vetted' for impact. In addition, these programmes are often tightly earmarked and thus evidence becomes irrelevant until the project funding period is over. Externally funded NGO-led projects are often required to report programmatic costs, but governments are not directly trading off these investments against other possible programmes and the focus on sustainability is limited. Instead, the Ministries of Health are occupied with coordination of programmes contingent on external funding cycles rather than driving implementation based on (local) evidence, as described in Mozambique:

"I see that the Ministry of Health goes with this programme but at the same time they are not preparing themselves for taking over. They still rely on the partners; that is the big issue. This programme depends too much on the partners"

- Community health implementer, Mozambique

6.4.4. Evidence use in priority setting for global financing and the role of global agendas on domestic financing

Globally, there is a stated or 'on paper' agreement about the need for evidence to underpin decisions, in part to address fairness concerns among those competing for financing. These fairness concerns were restated in calls by national level respondents for transparency in financing decisions by global-level financing mechanisms. Despite this stated commitment, political processes and prioritization exercises precede the evidence-based decisions in several cases. For example, the initial allocation of funds to HIV/AIDS, tuberculosis, and malaria respectively for each country from the Global Fund is made according to a formula. Subsequently, community health, as a component of the health systems strengthening envelope within the country allocation, has to 'fight' for resources from these disease areas. Similarly, in the Global Financing Facility of the World Bank, the reasons for selection of the priority countries was opaque, according to this key informant:

"How the 16 countries were selected, I'm not completely sure…well, partly it was our priority countries because there was a political economy angle to the countries from the donor side, so there's also these countries themselves who say they want…to be part of it so it will require they speak for themselves."

- Key informant, global

The biggest global items influencing community health, UHC and the United Nations' Sustainable Development Goals for health, were mentioned in each of the study countries by at least one respondent despite there being no direct question about it. Of the respondents who mentioned it, all national policy makers of funders of community health, several did not have a clear definition of UHC, potentially limiting its efficacy at motivating financing or policy shifts. However, they stated that pressure from global stakeholders towards UHC is increasing, without clarity what

evidence would be needed to measure progress toward this global goal. The perceived relationship of UHC to economic evidence was limited and primarily related to access to financial protection for community members, as stated by a policymaker in Kenya: "…*the Permanent Secretary and the Cabinet Secretary they were really looking at how community strategy can be used to reach people in the coverage of the National Hospital Insurance Fund"* .

The evidence being generated to support these global agendas were perceived by the majority of respondents to focus predominantly on feasibility and impact evaluations of small-scale pilots and programmes in specific locations, sometimes called 'pilot-itis'. This led respondents to be concerned that the resulting evidence is not relevant to other contexts, even within the same country. In those sites where CTC providers have greater curative responsibilities, particularly Ethiopia, respondents felt that a lot of community health evidence was not relevant to their 'highly-skilled' CTC providers, so they tended to call for more 'local evidence'. Seemingly in contrast, in Kenya national policymakers felt that devolution of decision making to sub-national administrative units at county level might have led to fragmentation of evidence needs, with demand for research and evaluation from each county." .

6.4.5. Quality of care not a priority in assessment of investments in community health

Quality of CTC care was usually termed 'performance' by respondents, and most respondents had low expectations of quality and performance. By the majority of respondents, CTC care was viewed as a means of expanding *coverage*, focusing largely on geographic barriers to care (e.g. >5km to a health facility) rather than social, economic or other barriers to equitable health care. They viewed this as reasonable given the relatively simple tasks allocated to most CTC providers and their limited levels of education and formal health training. Community health financing decisions, both domestic and external, have similarly emphasised the requirement for geographic spread over quality, and this was also a focus of responses that equated coverage with quality, with no mention of 'effective coverage':

"We've seen that they [the donor] are very much like we want a number of children immunised to be such and such; it's not about quality its really about numbers and coverage"

- Community health implementer, Ethiopia

At the national level, decision makers stated that the aspects of quality they would like to have evidence of included: improving health outcomes (in all countries), data quality (mainly Malawi and Kenya, with two mentions in Mozambique), ownership by and accountability of services to citizens (in all study sites except Ethiopia). Most stated that quality could be improved through better supervision and policy changes. In Ethiopia, respondents were more likely to mention health benefits in specific health areas and in some cases to describe meeting system-wide targets as a proxy for quality (e.g. quotas for percentages of deliveries attended by a skilled birth attendant). Across countries, evidence for improved quality that would be acceptable to participants included: changes in reporting rates for routine data on community health services, increased demand for services at primary healthcare facilities, decreasing burden of disease, and CHW/community satisfaction. However, many national level key informants acknowledged that quality was difficult and expensive to measure, as the challenges with routine data meant that understanding quality of care was perceived to require additional, non-routine data collection. As such, most respondents also had limited expectations for evaluations to be able to incorporate robust evidence on quality.

The design and integration of quality management structures in the Ministries of Health appeared to influence the appetite for economic evidence examining quality or performance. In Ethiopia and Mozambique, quality was a small part of the job description of technical staff in well-funded disease departments (e.g. malaria). In contrast, in both Kenya and Malawi, healthcare quality and standards were managed by a stand-alone department, supporting dedicated staff who promoted the quality agenda in evidence and decisions across the sector. Yet in these countries, quality management staff were sometimes marginalised or excluded from decision making due to a lack to technical health area focus, as shown in this example from Malawi:

"That was our original plan to have quality improvement persons in each [technical] department; we have one meeting and then the directorate [of

quality management] calling them but of course nobody showed up and that is the challenge these departments always have."

- Programme Implementer, Malawi

Yet even where there is an independent quality structure, getting that structure to consider the 'extension' of their mandate to community level could still prove a challenge, as continuing with the Malawi example illustrates:

"They [the directorate of quality management]…initially they were saying – 'why should we talk about the community?' and I said 'no, then you are joking'."

- Policymaker, Malawi

The same was true in Kenya, where the national Kenya Quality Model for Health had not been functionally extended to the community level or even disseminated by the National Department of Quality and Standards.

6.4.6. Non-evidentiary influences on decisions

At the immediate decision level, almost every discussion came back to a combination of limited relevant evidence and limited capacity to use the evidence that exists. This limited capacity was described as leading to a lack of demand for evidence and limited resources dedicated to commissioning or generating evidence, creating a vicious cycle. It also creates a vacuum that advocates of particular approaches or programmes were described as filling with their own priorities, through power and their political savvy. Decision makers try to juggle this influence alongside many other non-evidentiary limitations:

"…the decision makers, are they able to use comparative cost analyses against different programme and make sort of an effectiveness decision, sort of that? And I think the answer is no, that they will only use the data for decision making not in a vacuum, there's like a million other constraints...."

- Community health implementer, global

At the national level, the role of power over evidence appeared to be related to the degree of decentralization of the health sector, but this relationship was complex; decentralization was described as allowing space for more levels of 'politics and power', while also potentially increasing accountability due to proximity between

voters and decision makers, so it did not play out the same way in different locations but was dependent on individuals. Across the countries, contextual factors including varied responsibilities of community health workers, limited formal evidence consideration in most annual work planning procedures, and complex interactions between Ministries of Health and of Finance were seen to influence the likelihood of evidence use in decisions. Similarly, a couple global respondents identified that where programmes were not nationally led (but rather NGO-led), the geographic impacts would be piecemeal and may not be generalisable across the country.

Finally, interactions (i.e. power) and political viability were key to understanding decisions – both among global funders 'competing' for implementation space in priority countries and among national policymakers looking for re-election for themselves or their party, as well as between these global and national- level actors. This links to the negative public opinion that faces national and sub-national decision makers who try to use evidence to justify removing established services, or to disinvesting, as this Ethiopian policymaker described:

> *"Actually, it is very difficult for communities, for example some strategies being implemented for the last ten or fifteen years, the community is highlight dependent on that so there may be a resistance with the community [to stop funding something]."*

Despite this, global (international and bilateral) influence on national priorities was consistently present in the data and continues in large part because it comes with financial support – and expectations of delivering on donor priorities.

6.5. Discussion

This multi-country analysis on the use of evidence in community health in LMICs highlights a gap around the use of economic evidence in financing and policy decisions. We find limited use of evidence in decision making for community health and confirm findings from other studies that power and politics have noteworthy influence on priority setting. In explaining why evidence is not used, respondents described a lack of 'useful evidence', with available evidence perceived as not generalisable and not responding to the resource limitations on the ground, as well

as limitations in capacity to evaluate and apply the evidence meaningfully. Due to a predominance of external financing of CTC programmes, national decision makers are desensitised to the full costs of programmes. Donor priorities often fill the vacuum created by 'useful evidence' gaps, and this is reinforced by the unpopularity of disinvestment among constituents. CTC providers continue to be viewed as a means of increasing access to primary healthcare services; increased coverage of health services are the main benefits that decision makers expect from investment in community health, with quality (or effective coverage) and equity largely absent from participant-identified evidence gaps.

Evidence use in community health programming is constrained and influenced by contextual factors unrelated to the relevance and quality of the evidence. We conceptualise the influences on such decisions as coming from three levels: micro, meso, and macro as derived from the results; shown in Figure 1 (Caldwell and Mays, 2012). In the inner circle or micro level, we show the 'ideal' of evidenced-based policy setting and implementation, including priority setting, evidence assessment, decision making and financing.

At the meso level, we show the constraints on the ideal micro or decision level. The first constraint is environmental/epidemiological and service data availability and quality. At the meso level, routine community data quality is poor and most countries do not have recent sub-national data on epidemiology and costs of interventions. The second constraint stems from a lack of processes and procedures, were annual work planning is done primarily related to historical expenditure and programming. Marginalisation of community health from the 'formal' health system means fewer formalised procedural requirements for evidence use in decision making and less commissioning of such evidence (in comparison with other health areas). Because of these limitations in community health in many countries, even where evidence exists it is perceived as irrelevant and decision makers are not encouraged to use it. The third limitation is capacity for evidence selection, understanding and use in community health decision makers; this is a finding from consistent with wider studies in LMIC health systems (Stansfield et al., 2006; Wickremasinghe et al., 2016; McCollum, Taegtmeyer, et al., 2018; McCollum, Theobald, et al., 2018; Vanyoro et al., 2019). Comprehensive planning for community health programmes would

involve decision makers assessing an extensive set of routine data from health information systems that include: census, vital events, monitoring, public health surveillance, resource tracking, facility-based service statistics, and household surveys (Stansfield et al., 2006). Analysing these data, setting priorities and then aligning priorities to available resources are essential skills (Schneider and Nxumalo, 2017), and indeed in a recent study in Zambia, managers indicated that costing information highlighted priorities for more efficient use of resources in immunisation programming (Feldhaus et al., 2019). However, capacity strengthening around these transferable skills is rarely funded by vertical programmes, the main source of external financing for community health programmes (Conn, Jenkins and Touray, 1996). Increased capacity could increase the appetite for evidence and could be reinforced by involving policymakers in research activities whenever possible and bringing them to the ground to see what 'impact' and 'benefits' means to workflows in the health system and livelihoods in the wider communities, potentially overcoming political barriers to evidence use, similar to what Schneider proposes related to community health governance (Schneider, 2010).

Finally, at the macro level or outer circle, decisions are influenced by health sector structures, decision and fiscal spaces, funders and their priorities (Fiscal space , public finance management and health financing: a collaborative agenda, 2014; Katahoire et al., 2015a, 2015b; Greenhalgh et al., 2017; Pfadenhauer et al., 2017; Rajkotia, 2018). At the macro level, global institutions that finance community health programmes are more likely to formalise use of economic evidence. However, as a result of the levels of external financing, priorities of global institutions then have an outsize influence on domestic agendas, delinked from local evidence and need in many cases.

Overall, this builds on the work of McCollum et al. in the Kenyan context that the lack of high-quality, relevant evidence and limited capacity to use it, compounded by external influences mean the role of power and politics trumps evidence use in many community health programming decisions (McCollum, Taegtmeyer, et al., 2018). We add the generalisability of these findings beyond priority setting and into non-devolved systems. In this conceptual framework, the different aspects highlighted at each level illustrate where and how evidence could be leveraged, if available, to

overcome the role of power and politics in decision making to improve targeting of services and efficiency of the investments in health.

A core tenet of economics is that a decision maker ought to take into account both the benefits of the intervention as well as the resources required to achieve those benefits, then to compare these relative to other potential investments and make a rational choice (Varian, 1992). Our findings that respondents do not perceive current cost-effectiveness studies to reflect their budget constraints suggest that at a minimum, available studies do not accurately reflect the opportunity costs, perhaps due to inappropriate thresholds. Indeed, much critique of various thresholds (and in some cases, any thresholds at all) for cost-effectiveness has been levelled in the literature over the last ten years (Newall, Jit and Hutubessy, 2014; Marseille et al., 2015; Ochalek, Lomas and Claxton, 2015, 2018; Woods et al., 2016). In response to the push for UHC, the last five years have seen the development of a dizzying suite of investment cases, strategies targeting non-traditional donors and innovative approaches to promote consistent, sufficient financing of community health (Singh, Sullivan and Members, 2013; Global Financing Facility, 2016; Community Health Financing Compendium, 2017; Community Health Roadmap, 2019; Fernandes and Sridhar, 2017; Chou et al., 2018; E&K consulting, 2018). In most cases, this represents progress towards integration of community health into broader health systems, though priorities often continue to reflect donor concerns (likely in response to the fact that community health systems are still primarily funded by external financing in most countries). However, it is not clear who is the decision maker that is intended to be influenced by many of these cases and studies. Many of them target the Ministries of Finance and CTC programme leaders are rarely explicitly considered, nor are sub-national decision makers, despite an increasing emphasis on decentralizing decisions in LMIC health systems (Bossert and Mitchell, 2011; Otiso et al., 2017; McCollum, Limato, et al., 2018; Abimbola, Baatiema and Bigdeli, 2019). For this powerful evidence to be used and useful, it must consider the decision maker more explicitly and the constraints on their decision, e.g. through budget impact analysis rather than simply reporting incremental cost-effectiveness ratios against thresholds (Revill et al., 2014; Bilinski et al., 2017; Robinson et al., 2017; Ochalek, Lomas and Claxton, 2018).

As with any multi-country study and qualitative studies more generally, there are challenges to generalisability due to the contextual variation. However, the results were generally consistent enough to suggest actions for researchers and to commissioners and users of economic research evidence in the community health space. The selection of countries from within the REACHOUT consortium near the end of that programme period might have increased some of the key informants' consideration of and awareness of community health issues as part of the wider healthcare system in comparison to others in the region. The highly variation in degree of decentralisation of community health decisions could have also created less convergence around evidence use. In terms of positionality, the collection of data by a non-local researcher might limit the willingness of some respondents (especially government staff) to be fully frank, and similarly conducting interviews in English might have limited the nuance available to participants with more limited language proficiency.

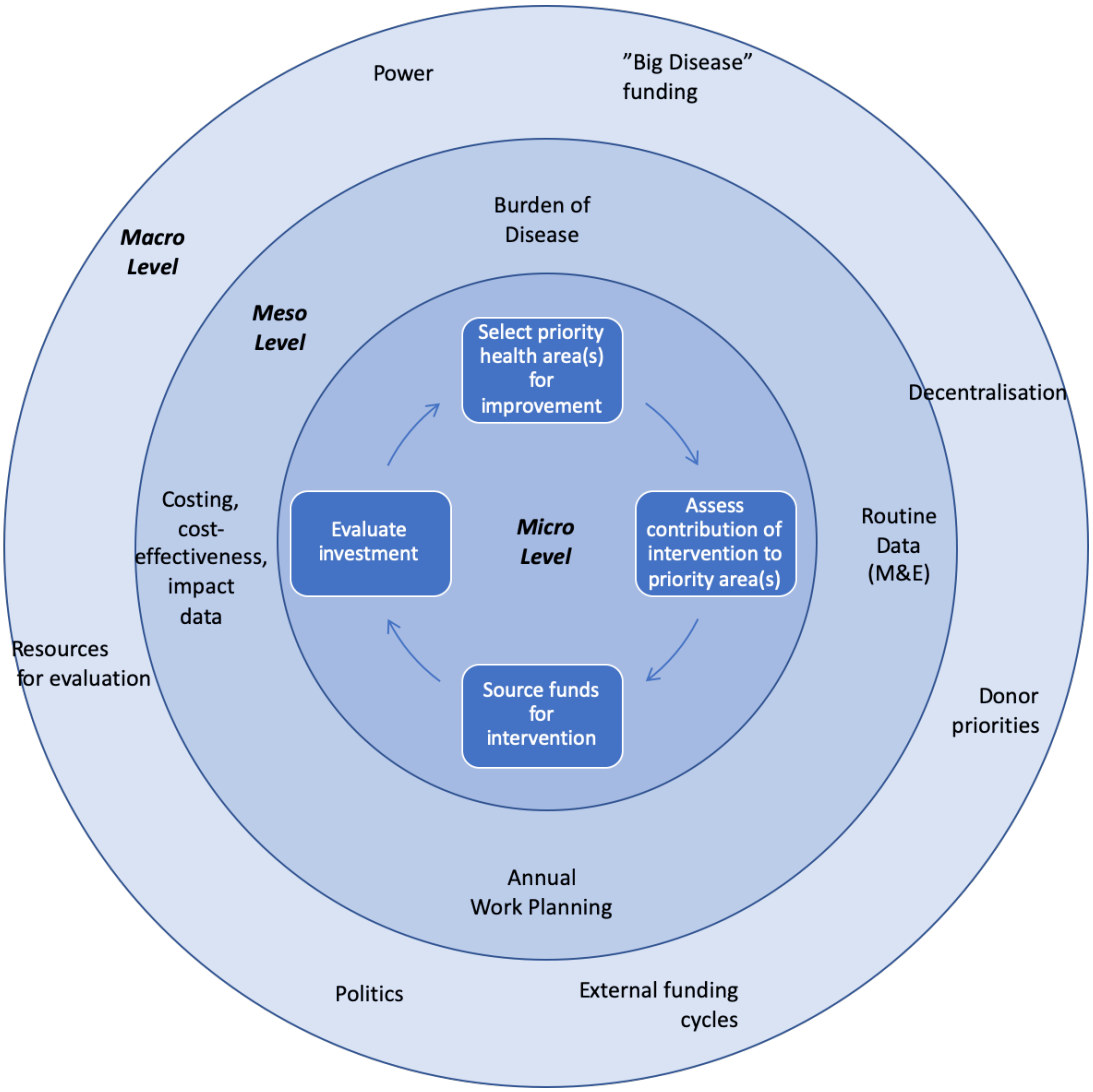

Figure 6.1: Conceptual framework for influences on community health programming decisions

6.6. Conclusions

In summary, there is ample room to improve and increase evidence use in community health programming and financing decisions. The goals of the health sector are in improving population health and health outcomes; additional benefits of improved quality of CTC health worker services are intrinsically valuable but even more complex to measure - aspects such as trust, motivation, inclusion, and adherence. Thus, decision makers focus on coverage as the priority benefit that they would like to see represented in evaluations of community health programmes, yet have limited resources to commission or undertake evaluations, and limited pressure to use the results. Politics further constrains decisions primarily in two ways: first, hardware investments such as hospitals, vehicles and equipment are easy election

'wins' and second, removing established services that are less (cost-)effective is politically challenging, even if evidence exists. If researchers and community health decision makers can bridge these gaps between them, the important value of evidence in improved community health programming and therefore improved population health will begin to be realised.

However, all potential approaches will have to overcome weaknesses in quality of available data, limitations in decision maker capacity and concerns about applicability of evidence expressed by respondents in this study.

7 Discussion

7.1. Summary of findings and contribution to the literature

This thesis examined the costs, and cost-effectiveness of QI for community health, as well as examining the use of evidence, including economic evidence by decision makers shaping policy and practice decisions for community health systems. These findings evaluate the capacity building and implementation conducted with sub-national community QI teams in different contexts. As summarised in section 2.7.1, there were two major evidence gaps identified in the literature review: a lack of economic evaluation of QI in community health and a lack of understanding of the evidence use in community health decision making. These evidence gaps are partially addressed by this thesis, and opportunities for building on the findings of this thesis to continue filling this gap are described in Section 7.7.

Specifically, to address the first gap, Chapters 4 and 5 provide evidence on costs, affordability and cost-effectiveness from a generic QI intervention in some settings, the first known economic evaluation of a community level QI intervention. Overall, the low per capita costs, budget impact and incremental cost effectiveness results suggest that QI at community level is a 'good buy', in terms of internationally agreed thresholds and quotas. The annual recurrent economic costs of integrating QI into current community health platforms range from $54 per CTC provider in Mozambique to $233 in Ethiopia, driven by costs of staff and volunteer time. The recurrent financial investment required is low across the different settings, as evidenced by the budget impact findings (0.03% to 0.58% of general government health expenditure) and is less than the capital costs (primarily training). Following on from this, such investment is likely to be cost-effective when QI teams focus on a specific health area – ICERs for the case study of ANC in Kenya are cost-effective at US$249.43/DALY. The estimates presented in Chapter 5 are likely to underestimate the benefits of QI. This is due primarily to three things: first, improvement was measured in maternal health although this was not the priority problem for all QI teams; it is likely that the observed impact underestimates potential impact. Second, QI teams are likely to handle more than one quality problem in a year, especially as they gain experience – so we have again underestimated the potential impact or

outcomes. Last, the benefits of community health work (and health systems strengthening interventions more generally) are yielded across more than one health area (e.g. in a home visit to a pregnant mother, CHVs might also check the vaccination card of other children in the household and refer defaulters for services).

The findings from Chapters 4 and 5 provide some indication of cost drivers and budgeting for other sites or countries interested in implementing this approach (with further discussion on generalisability in next section 7.2). This evidence may not be surprising; Nkonki et al. found all published economic evaluations of community health interventions cost-effective in their systematic review (49). Collins et al. provided early multi-country evidence from costing integrated community case management of fever that suggest given significant fixed costs of human resources, management and supervision, cost-effectiveness may be highly dependent on utilisation rates, a finding in common with Daviaud et al. in a different set of countries (50,51). It is well established that utilisation rate (or volumes of services provided by the health workers) is linked to quality, and it is here that our work links the limited community-level quality of care literature with the limited economic evaluations of community health work. These findings are now available in the public domain and is being shared back with country leadership to inform national decision making in study countries. Additionally, there is still an opportunity to estimate the value of the QI intervention where it has not yet been implemented using an estimate of cost-effectiveness. The economic implications of QI beyond the narrow area of maternal health in Kenya as presented in Chapter 5 are not yet well understood and present an opportunity for comparison in future research.

To address the second identified gap around evidence use in community health policy making, Chapter 6 explores the community health decision space in the study countries. This focuses the literature on evidence use in health policymaking more tightly on the sub-sector of community health. This paper extends existing literature on the influences on use of evidence in priority setting and decision making to the community health systems.

Despite low costs and low ICERs, qualitative interviews with a range of global and national key informants revealed that decision makers remain unconvinced by economic evidence, even if it is persuasive to an audience of health economists. They

cite concerns about whether existing research can be generalised to their setting and describe structural and capacity barriers to evidence commissioning and use; only two of more than forty respondents mentioned using cost-effectiveness evidence in recent community health-related decisions. The political challenges of the unpopularity of dis-investment or defunding current programmes was another barrier to using this type of evidence to drive financing decision. It is easier to justify new programmes with 'new' investment, so QI was often supported by short-term, externally-funded projects.

There is rich evidence on the translation of evidence to policy and practice, which our work extends to the community level of decision making. Koon et al. (2013) describe the process embedding health systems research in decision making in LMICs, emphasising both health system or contextual factors as well as factors about the evidence-generating organisation that increase trust in the evidence produced (52). This work focuses on evidence generated *in* a given context *for* the same context. More recently, Vanyoro et al. have explored the barriers to health systems research uptake in LMICs, emphasising 'ownership' as an important intermediate step between evidence generation and use in decisions, policy and practice (14). Both of these differ in a fundamental way from much of the economic evidence in community health for LMICs, which is often generalised from another setting and/or uses externally defined thresholds for cost-effectiveness, making it less trusted and thus less easily 'owned' by national decision makers. Packaging the evidence to suit the decision makers and use of knowledge brokers are both established strategies that might increase the likelihood of evidence uptake (29). The discussion of transferability of health system learning from other contexts in Witter et al. looks at a more experiential form of evidence, but still strongly emphasises the role of political economy and inter-personal relationships or trust (53). As in our study, these studies also highlight capacity gaps as a major barrier to evidence use. Coproduction of knowledge (in all aspects, including the design of funding calls, development of research questions, collection and analysis of data) has been proposed as a successful model to improve ownership; indeed, this approach was applied with some success by the REACHOUT country-level research teams described in this thesis through engagement of policymakers in annual meetings, context analysis and field

site visits both within and between countries. However, a recent commentary suggests that although costs are rarely measured, coproduction techniques can drive up research costs significantly, so the selection of an contextually appropriate, outcome-oriented approach is paramount to achieving the ascribed research ownership and uptake (54).

Economic evaluation of QI for community health has not been done before; this is a first step towards assessing its potential contribution toward UHC against other potential investments to increase quality and access to healthcare. Overall, the findings suggest that investing in QI for community health workers is likely worthwhile. That is, sustaining QI is likely affordable to national governments within budget constraints, if the capital costs of training are supported. The impact of QI, on the other hand, is more varied: it will depend on the intensity of the intervention and the health areas in which the CTC health workers are active in each context, as well as the level of system-wide commitment to quality and supervision. Systematic measuring of the benefits of QI on processes and outcomes should be a routine part of policy and practice to underpin investment decisions. Without evidence that speaks to decision maker needs, the value of this investment will not be realized and the investment will rarely be made given the political environment surrounding such decisions.

7.2. Generalisability of findings

The multi-country thesis findings were developed under the same ethos as the consortium, that is, to generate generalisable findings on CTC by using similar research methods to evaluate an intervention in multiple country settings with very different community health system structures. As described in Appendix 8, CTC providers' responsibilities, training, supervision and remuneration between (and even within) study countries vary widely (8,55,56). On top of contextual variation, for both implementation research and qualitative methodologies, discussion in the literature about barriers to generalisability persists (57–60).

One important consideration related to generalisability is whether the different study sites maintained fidelity to the original intervention design while they

appropriately modified to their context; this was also a concern described by respondents in Chapter 6. In Chapter 4, I discuss some of the variation or contextualisation of the intervention that influenced its cost – for example, the choice to have one or two levels of QI teams, and whether or not to provide additional financial support for QI interventions designed by the teams. However, the core intervention (phased training in QI concepts and methods, regular QI team meetings and QI interventions) of PDSA QI approaches for community health systems was built out of common findings from the REACHOUT context analysis and was consistently applied across study sites. In fact, these variations can help to identify cost levers and information for budgeting in new intervention sites – one aspect of the generalisability of the findings from Chapter 4 is the affordability in all settings regardless of the health systems structure.

Transferability or relevance of the evidence to other countries again may depend both on similarity between contexts on key parameters as well as the decision makers' views of relevance (2,58). To extend the example from above, in Chapter 4, results from different study sites provide information on what drives the costs under different contextualisation scenarios even as affordability seems consistent across the board. In the discussion of Chapter 6, I present a framework that suggests the possible influences of context on economic evidence use in community health decision making, which could help decision makers assess transferability of evidence to their settings.

Indeed, context is a core part of the success (or failure) of the studied intervention from both impact and sustainability perspectives, and its influence must be directly addressed and understood if this evidence is to drive good investment decisions in other contexts. The inter-contextual nature of my work allows me to draw some conclusions about the potential role of context on mechanisms and outcomes; this might be further explored and deepened by applying a realist lens, which is beyond the scope of this work (61). In brief, however, in examining the role of different aspects of context on the impact of community QI, the following factors appear to strongly influence implementation success of such a program:

- Level of system-wide commitment to quality: this drives a culture of quality; it may be evidenced by supervision meeting frequency, participation of

different seniorities of health workers in QI teams, existence of quality standards/guidelines/policies for different levels of the health systems

- Clear roles and responsibilities of the community health workers: with clear responsibilities, it is possible to define high-quality or standard levels of performance, which provides a foundation on which to ground QI efforts and targets
- Availability of small budget to reimburse transport costs for volunteers and to apply to QI 'solutions' designed by the teams: Even where team members are willing and/or interested, cost may be a barrier to participation, especially for low- or un-paid team members. Further investment in the teams, even if small, signals valuing their work and may drive commitment and more active implementation

Sustainability of a QI programme relates to contextual facilitators – it requires a combination of financial inputs and other resource inputs (e.g. health worker time) that may be at the discretion of a team or individual, depending on some of the facilitators (like culture, willingness, etc.) addressed above. From an economics perspective, contextual factors that are likely to influence sustainability of community QI may include:

- External financing: the larger the share of external financing, freedom of individual teams to choose investment areas is likely more limited; unless the donor supports QI, this may limit investment in this area
- Degree to which annual work planning is need or data-driven as opposed to historical: by using recent experience, needs, and data to decide, again the sub-national teams are likely to have more freedom to use QI in delivering their mandated work outputs
- Selection of the QI problem for initial QI intervention(s): early success in health areas prioritised in the health system and by supervisors will be an advantage in advocating for local investment
- Multi-level QI: the more supervisors and management teams are working with a similar approach, the more willing they are likely to be to support this

type of approach; very related to system-wide commitment to quality described above.

7.3. Revisiting the conceptual framework from literature review

In looking back at the conceptual framework used to understand the literature in light of the results, this remains a good generic framework for understanding and evaluating process or service delivery interventions upstream of clinical processes (90). It is a general approach to showcase how the distal health impacts are mediated and moderated by intervening variables. In applying this framework specifically to community health systems, one might replace management processes in the framework with the promotive and preventive responsibilities or tasks of CTC healthcare workers, generally upstream of care seeking and/or clinical activity (though of course this varies by typologies, as described in supplementary material in Appendix 8). Prior research in the community health space hints at what some of the intervening variables might be – trust between community, CTC providers and health system; motivation of health workers; approach and frequency of supervision (12,24,303,304,26,28,29,34,38,214,266,302) – and I have included these in a revised version of the framework shown in Figure 7.1 below.

When applied specifically to QI interventions in health, whether at community level or above, there are several points that might add nuance to the framework. First, considering QI as the generic intervention: intensity or level of investment in the intervention likely has an impact on both costs and outcomes. Second, adding the balance between contextualizing an intervention versus fidelity to the process intervention and the potential impact on outcomes. This is especially true for QI, where teams have a choice of problems even within the same system/structure/context.

The major missing piece of the framework became evident quite early: the decision maker. Without a clear understanding of this 'macro' piece of information, an economic evaluation is largely meaningless. The decision maker drives the choices of costs and outcomes to include and the assessment of the value of evidence to the particular decision(s) in the given decision space. Similarly, the 'rationality' of the

decision maker will affect how/whether/when they use evidence in their decisions, and how important the evidence might be against other criteria. In Figure 7.1, I show a revised version of the framework that some of these issues; the decision maker will be discussed in greater detail in the next section. This is intended for application specifically for economic evaluation of QI at CTC level; relevance to other interventions or other levels of the health system is not addressed herein.

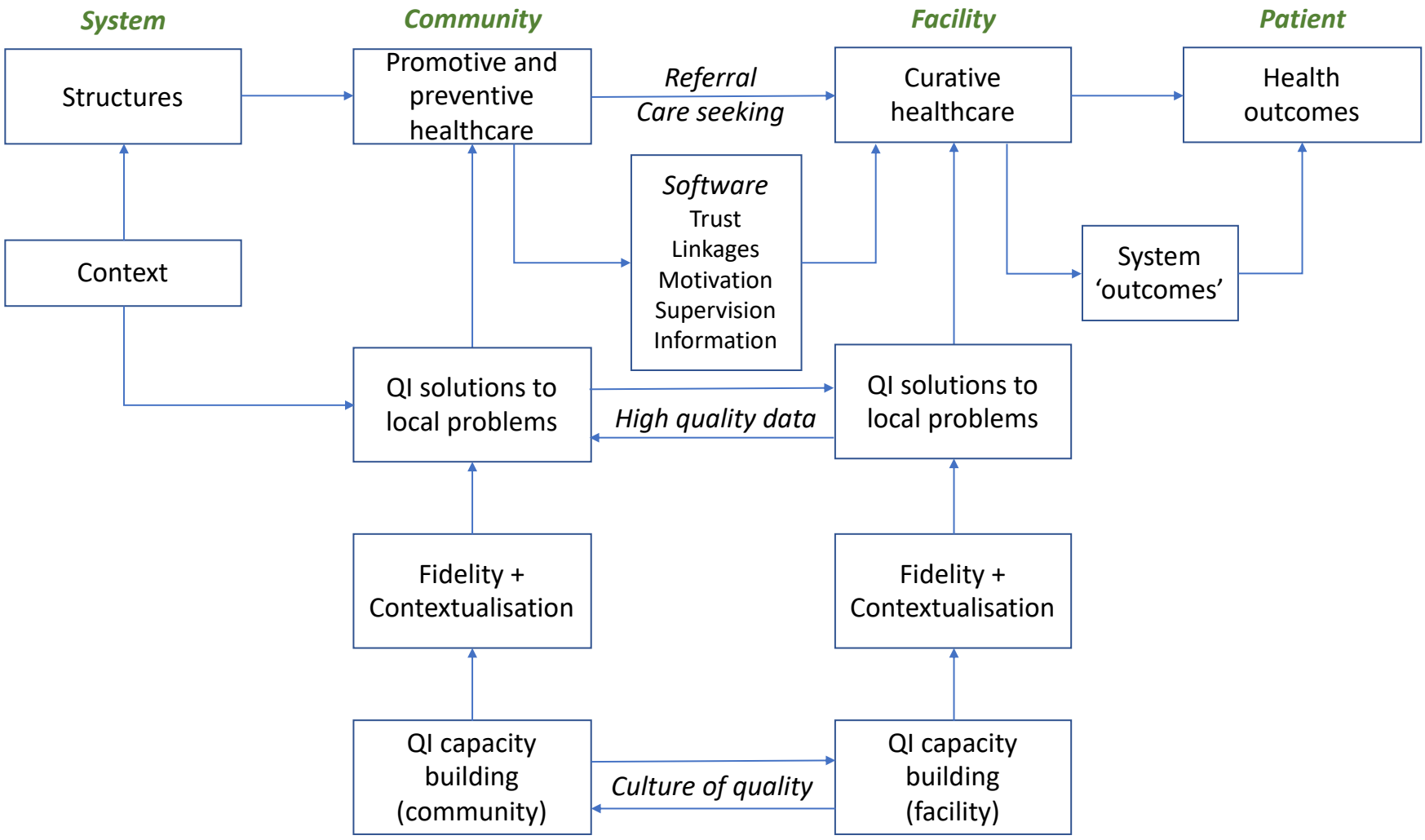

Figure 7.1: Revised conceptual framework for assessing QI for community health as a process intervention[6]

7.4. Key themes: interactions between papers

As described, the papers that make up the findings of the thesis build logically upon each other. In addition to that, the findings interaction and relate in ways beyond the scope of the papers themselves. I explore this in the sub-sections of 7.4 below, beginning with the centrality of the evidence users to this thesis research.

7.4.1. Economic evidence users: perspectives, decisions and priorities

An economic evaluation is designed to allow someone to assess and choose one course of action over another, so the scope, perspective and criteria for costs or consequences or both depend on the characteristics of the individual or group that is the target user of the evaluation (305). For each component of this work, the evidence user was at the heart: Which costs are relevant to or borne by them in Chapter 4? Which policy outcomes should be included beyond health impact in Chapter 5? Who should be interviewed in Chapter 6? As an economist, I expected identifying the evidence user to be fundamental but did not expect the degree of uncertainty it introduced.

The sub-field of health economic evaluation evolved in high-income countries, and the standard approaches to analysis reflect that, though recent work by several groups is aimed at elucidating and improving methods and reporting in LMICs (93,306). The interventions being evaluated in high-income settings are often 'simple' interventions: improvements in drug therapies and other clinical areas, proximal to health outcomes in the framework described above. Economic evaluations of these clinical interventions form part of what is known as 'health technology assessment'; with simple interventions, it is straightforward to see where improved therapeutic efficacy would drive a change in investment and replace another pre-existing drug, for example, though a recent systematic review found that disinvestment is challenging in all settings (133). In high income country settings, the evidence user is usually the 'payer', either a private insurance company or the public national health insurance; in some cases, this is even supported by an entire organisation whose role is to assess and compare technologies (e.g. the National Institute for Clinical Excellence or NICE in the United Kingdom).

The same systematic review discussed the limited recognition of the plurality of decision makers involved in health priority setting in LMICs (133). This aligns well

with my observations of community health for LMICs, where the decision makers (yes, plural) are distributed across different levels of the health care system as well as outside it. There is also a dichotomy between community health funders and policy/programme implementers, implying that there is no single authority, threshold, or perspective that can be used as the default 'evidence user'. In this study, there is the added dimension of a 'complex' intervention, as defined in Chapter 6.

To meet standards, economic evidence for LMICs would need to adhere to the CHEERS checklist and international decision support initiative reference case (93,219); Emerson and colleagues recently found that only 60% of recent cost-per-DALY studies met methodological standards (307). But with a multiplicity of evidence users in the decision space (or spaces), even selecting and defining the appropriate methodological approach is challenging. In Table 7.1 below, I synthesise the understanding from the studies that make up the thesis to describe the different evidence user typologies I have encountered. For each, I summarize their institutional objectives, key decisions related to community health, and use of economic evaluation in these. In the right three columns, I then describe the implications of those on the methodological approach to economic evaluation that might best satisfy their evidence needs.

Devolution in Kenya has generated some case studies on priority setting at subnational level and the opportunities for improvement through targeted evidence. Devolution presents a specific case example of this issue, formalising this multiplicity or heterogeneity of evidence users; however, it appeared in all the contexts where I worked regardless of the level of decentralisation. McCollum's recent work addresses some of this with a focus on the devolved or decentralised community health space in Kenya, describing the role of power and politics in interactions between the different levels of health system actors (139,140). Generally, priority setting literature has neglected this sub-national or meso level (308). In a recent case study of county health priority setting by Waithaka et al., they describe the role of informal or non-evidence based considerations on decisions, in alignment with the abovementioned findings of McCollum et al. (140,309). They suggest that making processes more explicit and systematic could improve the rationality of priority setting. Targeting (economic) evidence to user needs could then facilitate the use of

this evidence in these processes. However, this demands a lot from the evidence generators.

Table 7.1 summarises the methodological challenges related to the heterogeneity of evidence users as encountered throughout the studies. First, as described in Chapter 6, was the fact that community health programs are so heavily supported by external financing. As shown in Table 7.1, the second row represents many different institutions that may all be investing in community health and not always coordinated. This multiplies the number of evidence users (rather than adding), because 'external' is a single source of neither funds nor opinions. The multiplicity of external or donor priorities in combination with the unreliability of external funds can sometimes lead to unwillingness of local evidence users to express their own opinions (310). The second challenge is that each of these categories has different aims even if operating at the same level, and this translates into different costs and outcomes of interest and/or different perspectives on the evaluation (305,311). There is no correct perspective to take, but the perspective selected may affect the judgement of an intervention of cost-effective or not (I do not consider here the discussion on selection of thresholds, which continues in the literature beyond the scope of this thesis (98,288,289)). Community health presents an exacerbated case of the problem of inequitable cost distribution in provision of healthcare in LMICs; that is, many costs are borne by individual patients in out-of-pocket payments rather than through more equitable health financing mechanisms (312–314). In community health, this is made worse by the fact that this level of services is unlikely to be insured even for those with active insurance cover, and unpaid or low-paid health workers are also bearing costs considered outside the healthcare system. Thus, a health system perspective, while valuable to some decision makers, has impacts on equity that are not well included in traditional economic evidence. Finally, inclusion of the patient as a 'relevant' evidence user, while perhaps contentious to some in the context of priority setting, seems intuitive to most of us who have ever had to seek care for an illness and especially given the levels of out-of-pocket payments. This is described by Coast et al. and the consideration of costs and outcomes that are relevant are both immediate and obvious, though very different from those considered in most economic evaluations (315).

Table 7.1: Synthesis of evidence users' perspectives on economic evaluation evidence in community health decisions

Evidence user category	Level of the health ecosystem	Example organisations	Objective of their work in community health	Major community health decisions they make	Role of economic evidence in those decisions	Costs of interest	Outcomes of interest	Perspective
Norms and guideline development for community health	Global	WHO, United Nations (SDGs)	Consensus building around evidence	What are realistic goals for the global community and norms to facilitate reaching these goals	Limited for goals; primarily political agenda. There is a hierarchy for guideline development	Unclear	Access/equity and coverage; UHC	Societal (global?)
Financing for community health	Global	GFATM, GFF, USAID	Depends on the agency priorities	Which community programs to fund and mechanism of funding	Some; potentially in allocation decisions	Salaries, commodities, training	Access and coverage	Societal (global?)
Financing for community health	National	Ministry of Finance, MoH	Maximise productivity and health of the society within limited budget	How much money to give (community) health compared to other sectors	Described as 'horse trading'; potential for economic evidence use but not systematised in most cases	Salaries, commodities	Health outcomes	System
Policy for community health	National	MoH (specific depts: family health, reproductive health,	Appropriately share financing between curative and	How to define roles, responsibilities and activities of community health workforce	Most likely use of economic evidence here; may be used to advocate for reallocation from	Salaries, commodities, training, supervision, reporting	Number of units established, children covered or	System

Evidence user category	Level of the health ecosystem	Example organisations	Objective of their work in community health	Major community health decisions they make	Role of economic evidence in those decisions	Costs of interest	Outcomes of interest	Perspective
		community health etc.)	preventive health		other health investments		services delivered	
Implementation of community health	Sub-national (e.g. District, County, Province)	District Health Management Team; legislative representatives	Keep constituents healthy as possible at minimum cost	How to meet targets or get most health for available investment	Potential role but limited management experience and capacity for evidence use	Salaries, commodities, equipment, supervision, reporting	Meeting policy targets (e.g. % skilled deliveries); community satisfaction	System (sub-national or local)
Primary healthcare facility or unit	Sub-national (catchment)	Health facility and catchment	Provide required health services in timely manner	Which treatments to provide, to whom, by whom	Mostly in clinical (not health system strengthening) interventions	Commodities, supervision	Meeting policy targets (e.g. % skilled deliveries); community satisfaction	System (local)
Patient	Household	Individual or family	Maximise individual health; minimise costs	Where/when/ whether to seek treatment	Implicit; unlikely to use published evidence but out of pocket expense estimate and 'individual budget impact' is key	Travel, time, treatment	Individual health outcomes	Individual

7.4.2. Inclusion of equity in evaluation of community QI

As described, hierarchy of evidence and even relevance of evidence changes greatly based on the evidence user's perspective – and beyond the evidence user, the problem is compounded by a misalignment of payer, beneficiary and evidence user. When conducting economic evaluation of health systems strengthening interventions like QI, the ways different evidence users would value incorporation of equity is an important consideration.

A major stated motivation of CTC healthcare provision is to increase equity – primarily equity of geographical access to services. However, in the course of assessing the quality of services delivered as part of the QI intervention and the selection of problems by the QI teams, it became obvious that many of the quality issues dealt with equity. For example, adolescent mothers are less likely to reach four or more antenatal care visits than older mothers (198,316,317). Similar examples about immunization uptake in different sub-communities (e.g. marginalised tribal groups in urban areas) came up in the course of this implementation.

There are methodological approaches to including equity in economic evaluation that are becoming more robust, though again demanding high-quality data that is disaggregated both on the service utilisation and preferences for services. Multi-criteria decision analysis is one of these that has been much-lauded, and other approaches have been assessed in a recent systematic review (318–320).

When considering QI interventions specifically, there are two possible ways that QI teams themselves could be encouraged to incorporate equity in their intervention, whether as part of a formal evaluation or as part of routine monitoring in the health system. Here I consider each approach in the case of a worked example of QI for ANC, similar to Chapter 5.

- QI interventions could be targeted to specific sub-groups that are underserved: in the case of ANC, this would mean QI problems focusing on these specific communities or sub-groups (e.g. 42% of adolescent pregnancies in County X do not seek ANC until the third trimester). Focusing on problems like this would provide the obvious benefit that teams know their actions are going to improve equity for that group, and could include targeted outreach in high schools, focus on campaigns using popular stars,

etc. However, the challenge of this approach is that relies on the QI teams being able to identify these groups (ideally using disaggregated data, which is often limited) and their barriers to access. If part of the problem is that they are unseen or treated poorly by the health system, for example due to stigma associated with early sexual debut, it may be difficult for those within it who make up the QI teams to overcome those biases. Root cause analysis could potentially help with this but might require further research by the teams to identify these barriers if they are not part of or actively engaged with these groups already.

- An alternative approach is that 'success' of a QI intervention could be measured with outcomes that include equity explicitly. For example, coming back to the ANC example, one might look at a QI problem like "35% of pregnant women initiate ANC in the third trimester" and then examine the impact of our change on different groups, for example by parity or age. Then teams can see how different groups respond to the same intervention to solve a community-wide problem. This might be used in conjunction with the first approach: if teams first identify a broad problem, test an intervention and then see change only for married women, a second QI cycle focused on the same problem might then focus on adolescents.

Either approach would be possible and has both limitations and drawbacks; there is limited evidence on whether either approach produces higher impact, even from high-income facility-based settings (the source of most QI literature). Green et al. describe an ideal (theoretical) system of culturally competent QI, Lion et al. describe disparity-focused QI as a term to describe something similar, and Aysola and Myers share the need for equity-focused QI in medical teaching (321–323). Though these and other authors agree that QI has potential to reduce inequity or disparity, this potential is difficult to research and realise.

7.4.3. The meaning of costs and cost-effectiveness in the evaluation of QI in community health

Having initially separated the assessment of the primary data on costs of the QI intervention in Chapter 4 from the benefits modelled to estimate cost-effectiveness

in Chapter 5, there is a challenge in bringing these two together in a meaningful way. This has already been discussed to some extent in Chapter 5 with the development of ICERs and again above in section 7.2 looking at the role of context in each of these aspects. However, it would remiss to ignore potential interactions between the two beyond simple division. Here I will address three questions: first, what is the impact on outcomes if the system spends more (or less) on the intervention? And second, how sure is it that these outcomes will be yielded over time, given the model does not consider this? Linked to the second, how does the continuous aspect of the QI intervention (PDSA model) affect these dynamics?

The impact of costs on benefits may be guessed at from the differences in implementation or contextualisation presented in Chapter 4, a strength of the multi-country comparison therein. For Malawi and Ethiopia, project teams provided additional funding directly to the QI teams for their QI projects or interventions (e.g. in-service training for CHEWs to improve early pregnancy counselling to women and families to increase ANC attendance in the first trimester). This allowed the teams to act on a broader scale, sometimes with multiple community teams under the same district management and showing broader impact. Similarly, multi-level QI involving both community and district level teams as done in Ethiopia and Kenya meant that problems that were 'too big' for the lower-level team could be shared upwards, improving accountability and information flow. So generally, as intuition would suggest, increased investment meant increased benefit in these pilot implementations. However, once established, the teams that got neither form of 'additional' support were still able to function, meet regularly and implement change plans, suggesting that QI can be done within current budgets and scope if that is required due to constraints on time and/or other resources.

As with many interventions, for the case of QI the continued reaping of benefits will be dependent on health system functionality first of all: trained staff being in place and not transferred (or training new transfers), system support for QI (e.g. through participation of different levels in the teams), and a common understanding of quality (minimally, guidelines, roles and responsibilities) (72,73). This is why Vassall et al. have recommended incorporating constraints in economic evaluations in LMICs especially those recommending adoption of new technologies across multiple

settings – addressing epidemiological variation as well as demand and supply constraints. Yielding benefits beyond the 'project' lifespan is also contingent on the embedding or institutionalising of QI within existing systems and practices so it is not perceived as a burden (74,75). This is particularly challenging in the 'project' mentality of global health and development. The development industry has been heavily critiqued for an ostensible emphasis on sustainability while effectively creating uncertainty and even dependency instead (76,77). If QI is adopted as a management approach to routine performance perceived as useful and embedded in regular meetings, it may yield these expected or estimated benefits. If not, it is likely to fail, despite its low cost and potential for contribution to health system goals. Though linked to questions of equity presented in section 7.4.2, this is really a question of sustainability.

Lastly, the continuous nature of the QI intervention is of particular interest when assessing costs and outcomes and its sustainability. Most interventions provide a point improvement in a clinical process or health system (e.g. training of health workers on a new skill or introduction of a new diagnostic) that then either continues to provide benefits or dampens down over time as people revert to their pre-intervention behaviours and habits. QI is distinct from that because each cycle introduces a novel intervention – the QI intervention continues to spawn further cycles of change and action, if effective, which may focus on different points and processes. This provides the opportunity to yield a broad set of outcomes over time across health areas. The intervention studied, community QI, might yield outcomes such as increased breast-feeding rates, improved adherence to daily outpatient tuberculosis treatment, and/or decreased maternal mortality due to increased referral for facility-based delivery. The cyclical nature of the intervention also demands consideration in the costing, because the recurrent costs of the team-driven interventions are uncertain. I took the approach of using the first QI intervention or change plan (involving several actions by different groups) as the known costs and explored uncertainty around the number of cycles or interventions that might be completed in a year as part of the sensitivity analysis around the annualised costing. More could be done to assess and explore the dynamism of these costs and outcomes in a longer-term evaluation.

7.4.4. What kind of evidence should economists generate?

It is clear that in global health, the majority of interventions being tested and evaluated are primarily non-trial applications (329,330). A quick scan through my library of global health literature focuses on policy change, behaviour change, evidence to action, with a focus on operationalising, rationalising, 'making x useful', 'making x work for y'. This exciting, burgeoning field of implementation research has sometimes outstripped the methods required to rigorously evaluate and interrogate it (149,331–333). For example, economic evaluation has largely stuck to approaches born in a trial-based world where the impact of a drug or device is evaluated through a randomised control trial (RCT) setting. For example, when evaluators consider: "should malaria microscopy be replaced with rapid diagnostic tests" in an RCT, this minimises the challenges of re-training and turnover, side-lining the necessary investments in policy and guidance changes, dissemination and support – not to mention the political challenges of the laboratory unions that protest this change (334–338). There is need for incorporation and understanding of political economy, diffusion of innovation, soft operations research and much more interdisciplinary research to effectively answer these questions – to consider health systems as the complex adaptive systems that they clearly are. Recent papers are beginning to respond to this need but much of the literature is focused on defining these systems; it's time to move beyond that to leverage understanding of the defining characteristics of such systems to support system change, for example in QI (333,339–341).

At a minimum, it is clear that evidence users need to know the type (and ideally, scale) of inputs that would be required to yield the RCT-measured benefits, in addition to the cost-effectiveness. They would also like to know what contextual factors are important in the success of the intervention, and how to decide whether it's likely to work for them. And of course, budget impact – can they afford it, regardless of whether it is 'cost-effective' in the abstract? Economics of scale and scope, while often mentioned as opportunities for cost-saving, have rarely been concretely evaluated. Indeed, for the purpose of economies, focusing on achieving economies through integration of new interventions into procurement, workflow, etc. rather than scale is the most reliable and required evidence. Much has been focused on

increased knowledge translation in other areas of health research and there is an opportunity for health economists to learn from this (128,342,343).

7.5. Strengths and limitations of thesis approach to answering the research questions

In answering my aim of conducting an economic evaluation of QI approaches in community health systems, I was tied to working with an implementation team or teams. Specifically, with REACHOUT, the fact that country teams were more researchers than implementers provided me sounding boards and collaborators for understanding and publishing results (see many of my co-authors on papers in Chapters 4-6). In contrast, these dual roles sometimes meant that the implementation could have been done better (and might have shown greater impacts if it had been), though there is no counterfactual to which to compare. I excluded Bangladesh from all thesis studies, the sixth REACHOUT intervention country, because the QI intervention there focused on NGO-linked CTC providers. As such, embedding in the public system and the meaning of that were not clear. In further studies, looking at the role of this type of CTC provider and those from the private sector in these countries would be relevant to capturing heterogeneity in QI costs, cost-effectiveness and evidence use.

Certainly, there are expected impacts of 'nesting' any PhD within a larger project, both positive and negative. Shifting project timelines and competing priorities are often an issue, but for this study these was relatively minor influences. The fact that my PhD work began in the second half of the five-year REACHOUT project gave country implementation research teams time to establish their relationships (both intra-team and with relevant policymakers and health workers) and evaluating the intervention in a team with a couple years' collaboration experience meant much smoother working and implementation than at the project's outset.

However, an economic evaluation of a 'project' style implementation has important implications for the costs. Costs captured by the project teams were assumed to be high, both in terms of staff pay rates and the intensity of the intervention. In the costing study, Chapter 4, I adjusted for this by modelling and reporting scenarios of

MoH-led adoption of the intervention under different levels of intensity (active, passive, and base case). One can make critiques of a modelling approach generally and it may over- or under-estimate the costs. At a minimum, having reports from multiple countries gives us robust ideas of a relative costs of different parts of the intervention and aspects of the intervention and implementation that might drive costs in different settings. Despite this, it can be very challenging to get data (especially economic data, which can be viewed as sensitive) from public sector institutions, so nesting the PhD work in a larger study with local institutional presence was a strategic approach in that regard.

In terms of the order of study data collection and presentation in the thesis (Figure 3.1), I could have collected costs and then shared then with decision makers to elicit responses to concrete evidence and used those responses to shape the evidence that I produced on cost-effectiveness. However, the findings around evidence were not limited to economic evidence but rather more broadly about evidence-informed policy making and non-evidentiary influences. As such, it seemed most effective to be broad and understand the structure, processes and decision space around community health decision making rather than limiting key informant interviews to discussion of costing evidence, which is often separately considered from impact or outcomes evidence in the complex decision making ecosystem.

7.5.1. My positionality

My positionality is in part linked to the fact that my PhD was nested in REACHOUT, and this was discussed in Chapter 2, section 2.4. As the research manager of REACHOUT, I had a smooth entry into the five study countries and it was easy to get introductions to relevant respondents for my qualitative work when getting access to senior respondents in the government, NGO, and research sector would have been difficult or impossible in several locations without those introductions. This reduced the time it took to collect the data but increased the risk of response bias – knowing that I was not simply external to the setting but somehow involved in work in this area.

In the course of interviews, discussions on poor quality may be seen as reflecting on poor performance of individuals and teams. When speaking to global level respondents, these interviews were conducted primarily by phone or Skype, so the

opportunity to build a rapport was less. Though remote interviews on sensitive topics, especially voice only, are sometimes viewed as second best, they are still viewed as a rich source of data and themes by qualitative researchers (344–347). However, many of the individuals I interviewed were linked to me through other collaborators and colleagues, so again there was some level of trust that was intrinsic to those introductions. Unless time was prohibitive due to their schedules, I included aspects of their work and publications in my questions around the issues of interest to show my genuine commitment to understanding their work and to illustrate the applicability of my findings to their future work, potentially increasing uptake of the findings.

Lastly around the impact of positionality on my findings, I am not a native of Africa and am white. This 'outsider' status seemed at times to allow individuals to speak more freely, because they didn't expect that I was going to report back any negative comments to others in a way that might affect them or their career progression. However, there may have been some 'white-washing' of findings, both due to social desirability bias and to the assumption that I would not understand the contextual nuances (which is a fair critique that I sought to mitigate this through the active collaboration of my local research colleagues through each stage of the research). Consideration of the co-authorship on publications and the audience for the findings was also very much at the fore of my reflection on this issue (348,349); I have tried to be explicit about the possible influence of my positionality in the qualitative paper as well as in the fuller thesis.

7.5.2. Methodological strengths and weaknesses

Methodologically, there are similarly strengths and limitations of the approaches that I chose. The costing data, while primary data from the intervention is from a project and so necessarily has additional personnel, reporting and communication costs that would not be incurred in ongoing implementation; I have addressed this by looking at different approaches to adoption in a deterministic sensitivity analysis in Chapter 4. The benefits or impact data was not primary data, and so the choice of ANC as the priority health area as well as the approach to the model could be questioned. It would be valuable to try the same approach in multiple sites and health areas to compare the findings and assess robustness across settings. However,

there may be additional funding available to implement the community QI approach within a targeted health area, providing primary data from at least one site rather than further models with varying degrees of goodness of fit to the reality on the ground. The inclusion of a policymaker and implementing NGO colleague in the authoring team for that paper was helpful to mitigate the possibility of an abstract model that did not fit well with the realities on the ground. For the qualitative work, the sample size in each country was necessarily small (6-10 individuals) in order to achieve coverage in multiple countries. This likely means that nuance, especially at sub-national levels, was not included or captured. Individuals may have had an outsized influence on the summary of findings for each country due to the small sample size; I have tried to mitigate that by looking at different ways of grouping respondents (respondent types, levels, and countries) so that individual respondents are not always combined with the same others. Limitations related to the study site selection is already included in section 7.2 on generalisability.

7.6. Implications for evidence users

The intention of this thesis was always to provide clear, concrete and useable information to evidence users in the 'real world'; hence, in part, the decision to present the findings in a series of publications. However, as the nuance related to the evidence user described above in section 7.4.1 suggests, it is difficult to make recommendations without consideration of the context and decision space. Thus, the implications for decisions included here are not specific to any country context and are presented as considerations rather than recommendations, acknowledging my positionality (348,350). The thinking behind this draws heavily on pieces that I have recently co-authored or am currently developing (41,47,351) but all writing is my own.

7.6.1. Considerations for community health policymakers

For policymakers, the findings emphasise the value of community voices in several spaces – in improving quality, in decision making, and even in assessing quality.

- Establishing teams that collect, analyse and use data for QI is achievable at community level; the community themselves know their problems best and

will choose healthcare providers according to perceived quality and costs (30,302,352). With various types of support, this can change the quality of care delivered and experienced.

- Participatory forums that include community members and health workers can help decisions better reflect the perspectives of those bearing the costs of interventions, sometimes called “the final common pathway for all vertical programmes”
- Patient experience has been largely neglected in the definition and assessment of quality in community health programmes. However, if anything, the experience of a patient in a home visit is even more important (and, as unobserved, difficult to measure). This is an opportunity that in the early stages of consideration by LVCT Health in Kenya and Last Mile Health in Liberia (353).

7.6.2. Considerations for community health financiers

By keeping community health as a separate and distinct from general health expenditure, extension (note the same root as external) workers like CTC providers are viewed as separate from the health system. This has implications for both their working relationships with other ‘formal’ health workers as well as for the inclusion of these services in planning and budgeting discussions.

- Consider making financial contributions that are predictable and part of a wider health system pooled fund, allowing decision makers the space to use evidence (both published and that from community feedback)
- In contrast, request that community contribution to primary health care indicators (e.g. treatment of fever) be disaggregated in health management and information systems so that deliberations around funding support can be based on local evidence.

7.6.3. Considerations for health economists

The health economics of high-income countries is insufficient for direct transferability to LMIC settings. Particularly, the focus on ever-more sophisticated modelling approaches relies on high-quality, complete data sets that are rarely

available for LMIC settings. Some approaches that might improve the use of economic evidence are:

- Inclusion of mechanism in the publication of economic evaluation results; recognition of (at least) the direction of change that might occur if the prerequisites for that/those mechanism(s) are not met
- Acknowledgement of the multiplicity of decision makers in presentation of cost-effectiveness results and the potential impact, perhaps as a type of sensitivity analysis
- More research into disinvestment and ways to communicate trade-offs to constituent to facilitate evidence use by elected officials
- Default use of the societal perspective to more accurately reflect the costs that are often shifted to individuals through out-of-pocket payment and use of low/unpaid CTC providers

7.6.4. Considerations for community health implementers

For implementation in health systems, routine monitoring and evaluation systems provide an opportunity for ongoing or continuous research and improvement. Tracking progress and making those data publicly available, whether or not implementers themselves have the capacity to analyse them, is an initial step towards transparency and development of a national health policy and systems research agenda that incorporates community health. Building evaluation into these programmes for the purposes of system-level QI would be ideal, and could be improved by:

- Explicit inclusion of equity in the evaluation of community health programmes: the objective of community health is expanding access; reinforcing existing inequities of geography, disability, poverty etc. will not achieve that goal
- Inclusion of economics from the outset of evaluations: this does not mean every study should be a cost-effectiveness analysis or needs a counterfactual – rather, what it means is that if, as economists say, we live in a world of

limited resources then we must explicitly consider the resource impact of our decisions.

7.7. Recommendations for future research and future research collaborations

For future research, the immediate directions coming out of this are clear:

1) The field of global health is in need of health economists who are not (only) health technology assessment experts. In terms of research, this implies there is a need to develop and test mixed methods approaches to assess mechanism and impact of complex interventions, incorporating economics alongside realist evaluation, contribution analysis or other approaches that acknowledge the complex systems in which this evidence is being generated and used.

2) Just as we've done with the development of DALYs to overcome challenges of working across health areas, we need to develop ways of making explicit the considerations of multiple evidence users. In a setting where funding is (largely) external and the beneficiary is neither the payer nor the policymaker, the decision maker is not one person. Is the societal perspective enough to accomplish this goal, or how can economists present multiple perspectives or decision cases to make evidence relevant in more settings? This will also be more relevant as decentralization of decisions in healthcare becomes the norm in more LMICs aiming to improve equity and efficiency in their systems; national evidence will be insufficient to reflect epidemiological and policy variations (137,138,141,354).

3) Participatory facilitation methods and approaches are needed to elicit and incorporate the perspectives of diverse stakeholders, reflecting the complexity of the network of beneficiaries, the policymakers, the implementers and the payers affected by these decisions. This does not have to be – indeed, should not be – a research exercise. Rather, this is an opportunity for community dialogue and improving health system responsiveness to community needs, though these data (if collected routinely)

could also improve the relevance of evaluations. Perhaps community QI teams, where established, could be one forum for initiating these conversations and providing meaningful feedback to sub-national decision makers to drive responsive systems (148,274,355,356).

7.8. Conclusion

'Pilot-itis' is a term used by many to describe the status and approach to innovation in global health (357,358). It describes the way that health systems are often used by projects as guinea pigs, but the learnings are rarely shared and sustained in meaningful (quality) improvement to the systems.

In this thesis, I have described the challenges and opportunities for the use of economic evidence in community health and related decisions aimed at achieving UHC in LMICs. We live in a world of limited resources, so rationing of these is required. To make that rationing achieve the highest quality, most equitable outcomes requires strengthening the actual and perceived relevance of economic evaluation information to each decision maker. In parallel with improving the evidence, we must support and build the capacity of decision makers to understand and use it – and strengthen the systems so that they demand evidence in the course of decision making. By opening ourselves to interdisciplinary approaches and long-term associations, evidence generators, brokers and users might evolve into a more sustainable ecosystem of knowledge.

Appendix 1: Description of community health systems in study sites

This section is derived and expanded from the supplementary material to the paper presented in Chapter 6. Descriptions of community health worker typologies tend to incorporate some or all of the following dimensions: responsibilities and relationship to community and health facilities, selection and recruitment, training and supervision, remuneration and supplies. These have been described in detail by many publications, including those of the REACHOUT consortium and by the author as part of earlier work (8,9,304,11,22,27,29–31,33,156). Here I provide a brief description of the community health systems in each study site; further details on the typologies of the CTC providers in each site can be found the supplementary file to the publication in Chapter 4 (43), shown in Appendix 8.

Ethiopia

In Ethiopia, community health is fully institutionalized under the Ministry of Health. The main professionalized cadre of CTC providers are an all-female group called health extension workers. By policy, they are selected by their communities and two serve each community (approximately 5,000 people) at any given time (359). They receive training of one year in 16 "essential packages", including preventive and curative care for maternal and child health, as well as hygiene, disease prevention, and health education. They serve the community from Health Posts as well as doing household visits. They are supported by unpaid CTC providers called the Health Development Army and 1-to-5 group leaders who are the heads of model households (360). Health Extension Workers are supervised by Health Centre staff, the lowest level facility of the primary care system in Ethiopia, and *woreda* or district staff also have less frequent supervisory role. Successes of the health extension programme in various sites and health service areas are well documented, though opportunities for improving the quality and consistency of care remain (263,361). Published findings from the REACHOUT consortium on this community health system are available for further information (28,29,78,360).

Kenya

In Kenya, the community health strategy was established in 2006 and revised in 2014 (362). The current policy includes two tiers of community health workers: community health volunteers (CHVs) and Community Health Extension Workers (CHEWs), the latter of which was only officially included in the national scheme of service in 2013 (200). Though are both officially recognized, only the CHEWs are salaried government employees. Recommended ratios are one community health unit per approximately 5000 population, to be staffed by 5 CHEWs and 10 CHVs. Main responsibilities of both cadres are preventive and promotive health, with a focus on maternal and child health outcomes. CHEWs are linked to a primary health care facility (Level 2 or 3) and will supervise the CHVs; supervision is also provided directly by the sub-county health management team. Given devolution of health policy and decision making to the county (sub-national) level in the new Kenyan constitution of 2010, county policies on pay for the two cadres and key responsibilities vary (363). There have been many pilots of utilising CHVs to deliver various curative services but few of these have made it to policy and practice (295,364–367). Published findings from the REACHOUT consortium on this community health system are available for further information (23,78,139–141,368,369).

Indonesia

The Indonesian CTC healthcare system is founded on the *puskesmas*, or community health centre. At the *puskesmas*, there are a variety of healthcare providers including midwives, nutritionists, dentists and primary care physicians. In recent years, these have been combined with *posyandu,* or community integrated services, and the village midwifery program to combat persistently high maternal mortality rates (32,33). The *kader* or unsalaried CHV serves part of a village and is responsible for weighing of infants and basic maternal and family health promotion, though this is often of low quality due to the fact that they receive no formal training and are expected to learn on the job. The *kaders* receive infrequent supervision from a mixed group of supervisors; of these potential supervisors, only village midwives have medical qualifications and even the quality of their care is likely variable

(161,370,371). Evidence from REACHOUT suggests that quality of *kader*-provided care and information can be improved through simple, low-cost measures (372).

Malawi

The Malawian Ministry of Health has recently issued a new community health policy, the subject of much fanfare in the global UHC community (174). This policy focuses on the Health Surveillance Assistants (HSAs) and improving role clarity and support for them; next, the country is focusing on is using this evidence to mobilize resources for expanding coverage and ensuring salaries and commodities under the new plan (178,269,373). HSAs are nominated by their community, serving a population of approximately 1000, and receive 12 weeks of training focused on preventive health, family health and environmental health/sanitation. The HSAs also supervise CHVs and are supervised by senior HSAs, as well as by Environmental Health Officers and Community Nurses based at their link Health Facility (24,38). Reporting is done on Form 1A and summarized in Form 1B before being entered into the DHIS2 at the district level. Several papers have been published examining the poor data quality in this community health system and possible means to improve that (75,160,374). Published findings from the REACHOUT consortium on this community health system are available for further information (24,25,38,72,156).

Mozambique

In Mozambique, the community health programme is implemented by Agentes Polivalentes Elementares (APEs). Although founded in the 1970s, the programme had nearly died out and was recently revitalized in 2010-11 to create a salaried cadre of community health workers (375,376). APEs can be male or female and are elected by their communities and receive four months of residential training; this has been observed to be a barrier to equitable participation by both genders and men represent the majority of APEs (377). Most of the care APEs provide should be preventive and promotive, though when commodities are available they also do integrated community case management of fever or iCCM for children under five years old; referral is another important function they provide (378,379). APEs are

supervised by link facility staff and district health management teams, but this is intermittent (26).

Appendix 2: Adapting and contextualising the QI model in each study site

The common intervention of capacity building on QI in community health was implemented with 23 QI teams in 12 administrative areas (districts in Mozambique and Malawi, sub-counties in Kenya, *woredas* in Ethiopia, *puskemas* in Indonesia) of five countries (see Chapter 4, Table 4.1). The average size of each QI team was seven people and varied from four to ten. All members of each QI team were trained together and implemented the QI meetings and interventions together. In each country, intervention sites were selected for intervention in collaboration with public sector stakeholders building on earlier supportive supervision interventions for the CTC programs as part of the second phase of REACHOUT's work (researcher-led community QI). Fidelity to the protocol was high, with all sites led by trainers who were directly trained at the Training of Trainers (described as Step 2 in Figure 4.1) along with other colleagues, site-dependent, and with the country-adapted global training materials.

The dimensions of typology that appear relevant to the implementation of the intervention are described below:

1) Responsibilities: in each study, CTC health workers provide services for various health areas and undertake health-related activities. In all sites, these incorporate preventive health and maternal health in some capacity, hence the selection of antenatal care (ANC) for the modelling of benefits and estimate of cost-effectiveness of community QI in Chapter 5. However, many teams also have curative responsibilities and may extend to cover child health, non-communicable diseases, and other wider health responsibilities. These responsibilities were reflected in the selection of quality problems by QI teams at each site; an example sub-set of these is shown below in Table A2.1.

Table A2.1: Example QI problems from each study country

Country, Site	QI priority problem
Ethiopia, Abela health centre	Poor antenatal testing: 37% of pregnant women were not tested for syphilis; 48% were not tested for HIV
Kenya, Langata sub-county	In Langata Sub-County, 30% of community health volunteers do not submit their monthly reports as expected
Malawi, Salima district	78% of data (including community data) reported by Khombedza, Baptist & Lifuwu health centres is of poor quality
Mozambique, Manhiça district	Low frequency of supervision and feedback due lack of resources and availability of time by supervisors
Indonesia, *Puskesmas* Ciranjang	In 2015, 60% village midwives conducted only 6T (tasks) out of 10T for antenatal care

2) Supervision: in many cases, supervisors were both at the link facility (primarily a clinical supervisor) and at the district or sub-national level (primarily an administrative supervisor); approaches to supervision in the African countries and impacts on motivation were documented by Kok et al. (38). Variability of the supervision approach and responsibility was most directly reflected in the membership of the QI teams; see Table A2.2.

Table A2.2: QI team composition in each country

QI team composition	Kenya	Indonesia	Mozambique	Malawi	Ethiopia
Community member	Yes	No	No	No	No
CTC provider	Yes	Yes	No	Some	No
CTC supervisor	Yes	No	No	Yes	Yes
Facility representative	Yes	Yes	Yes	Yes	Yes
District representative	Yes	Yes	Yes	Yes	Yes

A few specific variations in the protocol were observed in different sites that may have led to different costs and/or outcomes:

- In Kenya and Ethiopia, two levels of QI teams were formed and trained. That is, in these sites, the training encompassed both a district-equivalent level QI team in each site as per protocol and added subsidiary community level QI teams – three subsidiary teams in community health units per sub-county in Kenya (for a total of 12 additional teams) and nine in health centre catchment areas per *woreda* in Ethiopia.
- In Indonesia, some *puskesmas* formed multiple QI teams to work on different QI problems in focus areas (e.g. nutrition and maternal health) concurrently. These were costed as separate teams and where personnel overlapped, their time was costed and accounted for in each team.
- In Ethiopia and Malawi, QI teams received an additional project-provided budget for implementation of QI activities. This likely represented a higher spend than teams would have had if left to manage their own implementation; one hopes that an increased spend might result in an increased benefit. However, since these countries were not represented in the cost-effectiveness study, this is noteworthy for an assessment of the costing results.

Appendix 3: List of related peer-reviewed publications to which I contributed as part of the wider REACHOUT consortium work

Nyirenda, L, **Kumar MB** et al (2020). "Using research networks to generate trustworthy qualitative public health research findings from multiple contexts". *BMC Med Res Meth* **20**, 13: https://doi.org/10.1186/s12874-019-0895-5.

Regeru, RN et al (2020). "'Do you trust those data?'—a mixed-methods study assessing the quality of data reported by community health workers in Kenya and Malawi". *Health Policy and Planning.* doi: 10.1093/heapol/czz163.

Agarwal, S et al (2019). "A conceptual framework for measuring community health workforce performance within primary health care systems". Hum Resources for Health: 17 (86): https://doi.org/10.1186/s12960-019-0422-0.

Limato, R et al. (2019). "What factors do make quality improvement work in primary health care? Experiences of maternal health quality improvement teams in three Puskesmas in Indonesia." *PLoS ONE* 14(12): e0226804. https://doi.org/10.1371/journal.pone.0226804

Karuga, RN et al (2019). "Supportive supervision of close-to-community providers of health care: Findings from action research conducted in two counties in Kenya". *PLoS ONE* 14(5): e0216444.

Doyle, V et al (2019). "The missing piece: quality in community health programmes". *Lancet Global Health:* Vol 7, March 2019.

Datiko, DG et al (2019). "Community participation and maternal health service utilization: lessons from the health extension programme in rural southern Ethiopia". *Journal of Global Health Reports; 3: e2019027.*

Kok, MC et al (2018). "Does supportive supervision enhance community health worker motivation? A mixed-methods study in four African countries". *Health Policy and Planning*. doi: 10.1093/heapol/czy082.

Appendix 4: Quality assurance approaches

To ensure that the data collected were of an acceptable quality, preliminary versions of all tools were shared with and commented upon by PhD supervision team. Final versions of the tools were piloted in advance to ensure quality and acceptability of the tools.

For the qualitative data:

- Consideration of whether translated versions of the tools were necessary and any sensitive content was discussed in advance of fieldwork as part of the local ethical approval processes.
- I conducted all qualitative interviews except where languages other than English was required (n=4 of 43; languages used: Amharic and Portuguese). Only researchers with previous experience in collection of qualitative data and appropriate local language skills were recruited (from the REACHOUT country teams) for support of data collection in local languages. Researchers were refreshed on collecting the various types of data, the importance of respectful attitudes, probing and non-leading questions etc. I directly supervised the fieldwork and participated in interviews and we worked together on quality assurance procedures (checking recordings, keeping field notes etc.).
- Data validity was judged via triangulation (comparing and contrasting results from in-depth interviews and answers from different categories of respondents and across country settings).
- Reflection on positionality formed an important part of the analysis process and is discussed further in Chapter 7.
- Interviews and FGDs were digitally recorded if consent provided (n = 39 of 43), transcribed and, where applicable (n = 4), subsequently translated into English
- In the event that participants refused to give consent for digital recording but did consent to the interview/ discussion (n = 2 of 43), I relied on note-taking and entered interview notes in the database for coding. These notes/interviews were not used for quotations, reflecting possible inaccuracies introduced in the note-taking process.
- Any quotes are presented in anonymous form.

For the quantitative data:

- The costing data collection tool was piloted in Kenya prior to finalisation.
- The tool was directly completed by multiple country team respondents together and reviewed by the PI in a workshop to ensure accuracy

All data were anonymized and stored on a password-protected computer, with backup to a remote cloud server (also under password protection). Data were only accessed by the research team.

Appendix 5: Ethical approvals

Ethical approval was obtained from LSTM as well as each country where field work was conducted; official confirmation and details of each approval are included here.

LSTM
LIVERPOOL SCHOOL
OF TROPICAL MEDICINE

Pembroke Place,
Liverpool, L3 5QA, UK
Tel: +44(0)151 705 3100
Fax: +44(0)151 705 3370

www.lstmed.ac.uk

Mrs Meghan Bruce Kumar
PO Box 357-00606
Nairobi
Kenya

Friday, 29 September 2017

Dear Mrs Bruce Kumar,

Re. Research Protocol (17-009) Achieving quality in the complex adaptive system of community-based healthcare

Thank you for your letter of 25 August 2017 responding to the action points raised by the Committee and your email of 30 August 2017 providing the necessary Kenya and Malawi in-country approvals for this project. I can confirm that the protocol now has formal ethical approval from the LSTM Research Ethics Committee for Kenya and Malawi based research activity.

The approval is for a fixed period of three years and will therefore expire on 28 September 2017. The Committee may suspend or withdraw ethical approval at any time if appropriate.

Approval is conditional upon:

- Continued adherence to all in-country ethical requirements.
- Notification of all amendments to the protocol for approval before implementation.
- Notification of when the project actually starts.
- Provision of an annual update to the Committee.
  Failure to do so could result in suspension of the study without further notice.
- Reporting of new information relevant to patient safety to the Committee
- Provision of Data Monitoring Committee reports (if applicable) to the Committee

Failure to comply with these requirements is a breach of the LSTM Research Code of Conduct and will result in withdrawal of approval and may lead to disciplinary action. The Committee would also like to receive copies of the final report once the study is completed. Please quote your Ethics Reference number with all correspondence.

Yours sincerely

Dr Angela Obasi
Chair
LSTM Research Ethics Committee

Mrs Meghan Bruce Kumar
PO Box 357-00606
Nairobi
Kenya

LSTM
LIVERPOOL SCHOOL OF TROPICAL MEDICINE

Pembroke Place,
Liverpool, L3 5QA, UK
Tel: +44(0)151 705 3100
Fax: +44(0)151 705 3370

www.lstmed.ac.uk

Thursday, 19 October 2017

Dear Mrs Bruce Kumar,

Re. Research Protocol (17-009) Achieving quality in the complex adaptive system of community-based healthcare

Thank you for your correspondence of 19 October 2017 providing the necessary Mozambique in-country approvals for this project. I can confirm that the protocol now has formal ethical approval from the LSTM Research Ethics Committee for Mozambique based research activity.

The approval is for a fixed period of three years and will therefore expire on 18 October 2020. The Committee may suspend or withdraw ethical approval at any time if appropriate.

Approval is conditional upon:

- Continued adherence to all in-country ethical requirements.
- Notification of all amendments to the protocol for approval before implementation.
- Notification of when the project actually starts.
- Provision of an annual update to the Committee.
  Failure to do so could result in suspension of the study without further notice.
- Reporting of new information relevant to patient safety to the Committee
- Provision of Data Monitoring Committee reports (if applicable) to the Committee

Failure to comply with these requirements is a breach of the LSTM Research Code of Conduct and will result in withdrawal of approval and may lead to disciplinary action. The Committee would also like to receive copies of the final report once the study is completed. Please quote your Ethics Reference number with all correspondence.

Yours sincerely

Dr Angela Obasi
Chair
LSTM Research Ethics Committee

LSTM
LIVERPOOL SCHOOL
OF TROPICAL MEDICINE

Pembroke Place,
Liverpool, L3 5QA, UK
Tel: +44(0)151 705 3100
Fax: +44(0)151 705 3370

www.lstmed.ac.uk

Mrs Meghan Bruce Kumar
PO Box 357-00606
Nairobi
Kenya

Wednesday, 28 November 2018

Dear Mrs Bruce Kumar,

Re. Research Protocol (17-009) 'Achieving quality in the complex adaptive system of community-based healthcare'

Thank you for your letter of 02 November 2018 and providing the necessary Ethiopian in-country approval for this project. I can confirm that the protocol now has formal ethical approval from the LSTM Research Ethics Committee for Ethiopia based research activity.

The approval is for a fixed period of three years and will therefore expire on 28 November 2021. The Committee may suspend or withdraw ethical approval at any time if appropriate.

Approval is conditional upon:

- Continued adherence to all in-country ethical requirements.
- Notification of all amendments to the protocol for approval before implementation.
- Notification of when the project actually starts.
- Provision of an annual update to the Committee.
  Failure to do so could result in suspension of the study without further notice.
- Reporting of new information relevant to patient safety to the Committee
- Provision of Data Monitoring Committee reports (if applicable) to the Committee

Failure to comply with these requirements is a breach of the LSTM Research Code of Conduct and will result in withdrawal of approval and may lead to disciplinary action. The Committee would also like to receive copies of the final report once the study is completed. Please quote your Ethics Reference number with all correspondence.

Yours sincerely

Dr Angela Obasi
Chair
LSTM Research Ethics Committee

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South Nations Nationalities and People's Regional
State Health Bureau

ቁጥር ዩ026-19/16895
Ref. No
ቀን 23/02/2011
Date

Southern Nations Nationalities and Peoples Regional State Health Bureau Health Research Ethical Clearance Form (Office use)

Name of the applying principal/s (PI/s) :- Meghan Bruce Kumar
Name of the applying/applicant's/ institution : - LSTM LIVERPOOL SCHOOL OF TROPICAL MEDICINE
Address of the applying PI(s) (Mobile) +254733440052

Title of the project :- Achieving quality in the complex adaptive system of community- based healthcare.

Dear/Sir/Madam,

The Regional Health Bureau Research Ethical Review Committee has reviewed the aforementioned project proposal with special emphasis on the following points;

	Yes	No
1. Are all ethical principles considered?		
1.1 Respect for person	☒	☐
1.2 Beneficence:	☒	☐
1.3 Justice:	☒	☐
2. Are the objectives of the study ethically achievable?	☒	☐
3. Are the proposed research methods ethical sound?	☒	☐

Comments of the ethics committee:

Based on the above mentioned ethical assessment the regional Ethical clearance committee has

A. Approved the proposal for implementation ☒
B. Conditionally approved ☐
C. Not approved ☐

The time period allowed for this stud is 7 Months. The study should comply with the standard international and national scientific and ethical guideline. Any change to the approved protocol, any adverse or unanticipated events should be reported within 48 hours to Regional Health Bureau. Be informed that the regional health bureau ethical review committee has right and responsibility to conduct surprise and/or informed supervision of your work during the study.

S.no	Reviwe committee Membe	*Signature*	Responsibility
1.	Mr. Misganu Endrias		Secretary
2.	Mr. Tebeje Misganaw		Member
3.	Mr. Lopiso Erosie		Member
4.	Mr.Sinafikish Ayele		Member
5.	Sr.Fekert Abera		Member

Chairman of REC **Signature** **Date**

Emebet Mekonnen Fara
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Health research and technolgy
transfer support process owner

Southern Nations Nationalities and Peoples Regional State Health Bureau

CC
Health Research and Technology Transfer Support Process
RHB,Hawassa

✉ 149 ☎ (20-92-09) Fax 20-57-92 E-mail snnpdhl@telecom.net.et Code 251-0462

KEMENTERIAN RISET, TEKNOLOGI DAN PENDIDIKAN TINGGI
KOMITE ETIK PENELITIAN KESEHATAN
Fakultas Kedokteran Universitas Hasanuddin
RSPTN Universitas Hasanuddin
RSUP dr. Wahidin Sudirohusodo Makassar
Sekretariat : Lantai 2 Gedung Laboratorium Terpadu FKUH
JL.PERINTIS KEMERDEKAAN KAMPUS TAMALANREA KM.10 MAKASSAR 90245
Contact Person: dr. Agussalim Bukhari, MMed, PhD,SpGK Telp. 081241850858, Fax : 0411-581431

REKOMENDASI PERSETUJUAN ETIK

Nomor : 597 /H4.8.4.5.31/PP36-KOMETIK/2016

Komisi Etik Penelitian Kesehatan Fakultas Kedokteran Universitas Hasanuddin, RSPTN UH, RSUP dr. Wahidin Sudirohusodo setelah melalui pembahasan dan penilaian, memutuskan penelitian berjudul:

Intervensi Peningkatan Kualitas Siklus 1 Tenaga Kesehatan ibu di Lini Terdepan untuk Meningkatkan Pelayanan Kesehatan Ibu di Indonesia

dengan Peneliti Utama: **Prof. dr. Syafruddin.,PhD**

No. Register	U	H	1	4	1	2	0	6	5	9

Yang diterima pada tanggal : **12 April 2016**

Perbaikan diterima pada tanggal :

dapat disetujui untuk dilaksanakan di **Cianjur, Provinsi Jawa Barat.**
Persetujuan Etik ini berlaku satu tahun sejak tanggal ditetapkan. Laporan perkembangan penelitian diserahkan kepada KEPK FKUH, RSPTN UH dan RSWS Makassar setiap ~~tiga bulan/enam bulan~~/satu tahun.
Pada akhir penelitian, **laporan akhir penelitian** harus diserahkan kepada KEPK FKUH, RSPTN UH dan RSWS Makasar paling lambat **11 Mei 2017 .** Jika ada perubahan protokol dan /atau perpanjangan penelitian, harus mengajukan kembali permohonan kajian etik penelitian (amandemen protokol).

Makassar, *11 Mei 2016*

Komisi Etik Penelitian Kesehatan Fak. Kedokteran Unhas

Ketua	Sekretaris
Prof.Dr.dr.Suryani As'ad,M.Sc,Sp.GK	**dr. Agussalim Bukhari,PhD ,SpGK**
NIP 19600504 1986 01 2 002	**NIP 19700821 1999 03 1 001**

KENYA MEDICAL RESEARCH INSTITUTE

P.O. Box 54840-00200, NAIROBI, Kenya
Tel (254) (020) 2722541, 2713349, 0722-205901, 0733-400003; Fax: (254) (020) 2720030
E-mail: director@kemri.org info@kemri.org Website:www.kemri.org

KEMRI/RES/7/3/1 **November 6, 2014**

TO: **LILIAN OTISO (PRICNIPAL INVESTIGATOR)**
LVCT HEALTH,
P.O. BOX 19835-00202,
NAIROBI, KENYA

Dear Madam,

RE: **NON-SSC PROTOCOL NO 447 (*RESUBMISSION 2):* HAQIQA NYUMBANI: A STUDY ON ENHANCEMENT OF SUPERVISION FOR COMMUNITY HEALTH SERVICES IN KENYA (*VERSION DATED 20TH OCTOBER, 2014)***

Reference is made to your letter dated 22nd October, 2014. The ERC Secretariat acknowledges receipt of the revised study protocol on October 23, 2014.

This is to inform you that the Ethics Review Committee (ERC) reviewed the documents submitted and is satisfied that the issues raised by the 229th meeting of the KEMRI ERC on 22nd July, 2014 have been adequately addressed.

The study is granted approval for implementation effective this **6th November, 2014**. *Please note that authorization to conduct this study will automatically expire on* **5th November, 2015.** *If you plan to continue with data collection or analysis beyond this date, please submit an application for continuing approval to the SERU by* **September 24, 2015**.

Any unanticipated problems resulting from the implementation of this protocol should be brought to the attention of the SERU. You are also required to submit any proposed changes to this protocol to SERU prior to initiation and advise them when the study is completed or discontinued.

You may embark on the study.

Yours faithfully,

EAB

PROF. ELIZABETH BUKUSI,
ACTING SECRETARY,
KEMRI/ETHICS REVIEW COMMITTEE

KENYA MEDICAL RESEARCH INSTITUTE

P.O. Box 54840-00200 NAIROBI - Kenya
Tel: (254) (020) 2722541, 254 (020) 2713349, 0722-205901, 0733-400003 Fax (254) (020) 2720030
Email: director@kemri.org info@kemri.org Website: www.kemri.org

KEMRI/RES/7/3/1 **July 11, 2016**

TO: **LILIAN OTISO (PRINCIPAL INVESTIGATOR)**
LVCT HEALTH,
P.O. BOX 19835-00202,
NAIROBI, KENYA

Dear Madam,

RE: **NON-SSC PROTOCOL NO 447 (*RESUBMITTED-AMENDMENT 1):* HAQIQA NYUMBANI: A STUDY ON ENHANCEMENT OF SUPERVISION FOR COMMUNITY HEALTH SERVICES IN KENYA.**

Reference is made to your letter dated 4th July, 2016. KEMRI/Scientific and Ethics Review Unit (SERU) acknowledges receipt of the revised documents on 5th July, 2016.

This is to inform you that the Committee determines that the issues raised at the 251st Committee C meeting of the KEMRI/SERU held on 26th May, 2016 are adequately addressed.

You are therefore **authorized** to implement the following Amendments accordingly:

1. To drop **four** community units as study sites from the initial **eight** suggested. Only four Community units will remain as study sites, **two** in **Nairobi** (one per Sub County) and two in**Kitui** (both in one Sub County).
2. To assess the quality of data in the Community Health Information System as a process indicator of the study through observation of participants, verification of records, in-depth interviews and focus group discussions (FGDs) with participants.
3. To collect additional information on CHC activities towards the fulfilment of objective three. This will entail conducting FGDs and in-depth interviews on the participants

Please note that you are responsible for submitting any further changes to the approved version of the study protocol to SERU for review and the changes should not be initiated until written approval from the SERU is received.

Yours faithfully,

Fdt.

DR. EVANS AMUKOYE,
ACTING HEAD,
KEMRI/SCIENTIFIC AND ETHICS REVIEW UNIT

Telephone: + 265 789 400
Facsimile: + 265 789 431

All Communications should be addressed to:

The Secretary for Health and Population

In reply please quote No. .....

MINISTRY OF HEALTH AND POPULATION

P.O. BOX 30377
LILONGWE 3
MALAWI

06 September, 2017

Hastings Banda
Reach Trust

Dear Sir/Madam,

RE: PROTOCOL 1286: Quality Improvement cycle to improve Performance of Close to Community Providers of Health Care Services in Malawi.

Thank you for the above titled proposal that you submitted to the National Health Sciences Research Committee (NHSRC) for review. Please be advised that the NHSRC has reviewed and approved your application for **continuation** of the above titled study.

- **APPROVAL NUMBER : 1286**
- The above details should be used on all correspondences, consent forms and documents as appropriate.
- **APPROVAL DATE : 06/09/2017**
- **EXPIRATION DATE**
  This approval expires on **05/09/2018**. After this date, this project may only continue upon renewal. For purposes of renewal, a progress report on a standard form obtainable from the NHSRC Secretariat should be submitted one month before the expiration date for continuing review.
- **SERIOUS ADVERSE EVENT REPORTING:** All serious problems having to do with subject safety must be reported to the NHSRC within 10 working days using standard forms obtainable from the NHSRC Secretariat.
- **MODIFICATIONS**: Prior NHSRC approval using forms obtainable from the NHSRC Secretariat is required before implementing any changes in the protocol (including changes in the consent documents). You may not use any other consent documents besides those approved by the NHSRC.
- **TERMINATION OF STUDY**: On termination of a study, a report has to be submitted to the NHSRC using standard forms obtainable from the NHSRC Secretariat.
- **QUESTIONS**: Please contact the NHSRC on telephone number *+265 1 726 418 OR 0888344443* or by email on mohdoccentre@gmail.com
- **OTHER**: Please be reminded to send in copies of your final research results for our records (Health Research Database).

Kind regards from the NHSRC Secretariat.

SECRETARY FOR HEALTH
2017 -10- 09
P.O BOX 30377, CAPITAL CITY, LILONGWE 3

.....

For: **CHAIRPERSON, NATIONAL HEALTH SCIENCES RESEARCH COMMITTEE**
Promoting Scientific and Ethical Conduct of Research in Malawi[1]

Comité Institucional de Bioética em Saúde da Faculdade de Medicina/Hospital Central de Maputo (CIBS FM&HCM)

O Dr. Jahit Sacarlal, Presidente do Comité Institucional de Bioética em Saúde da Faculdade de Medicina/Hospital Central de Maputo (CIBS FM&HCM)

CERTIFICA

Que este Comité avaliou a proposta do (s) Investigador (es) Principal (is):
Nome (s): MOSHIN SIDAT
Protocolo de investigação com Adenda 2 datado de Outubro de 2017
Consentimento informado: versão 2 de 1 de Setembro de 2014
Questionário – sem versão datado de Março de 2017
Guião de entrevista – sem versão datado de Março de 2017
Do estudo:
TÍTULO: *"REACHOUT- Implementação de Ciclos de Melhoria de Qualidade dos Serviços Prestados pelos APE´s nos Distritos de Manhiça e Moamba, na Província de Maputo, Moçambique."*

E faz constar que:
1º O CIBS FM&HCM ***APROVA a ADENDA 2*** *sobre analise de custos ao protocolo* ***CIBS FM&HCM/45/2014.***
2º O CIBS FM&HCM ***APROVA*** *o pedido da 3º* ***EXTENSÃO*** *do protocolo* ***CIBS FM&HCM/45/2014*** *por um período de 12* ***meses*** *terminando assim a validade no dia* ***10 de Setembro de 2018.***
3º Um mês antes dessa data o Investigador deve enviar um pedido de renovação se necessitar.
4º Recomenda aos investigadores que mantenham o CIBS FM&HCM informado do decurso do estudo na base semestral até o término do estudo.

E emite
RESULTADO: ***APROVADA A ADENDA 2 E EXTENSÃO PROTOCOLO.***

CIBS FM & HCM

Assinado em Maputo aos 17 de Outubro de 2017

Appendix 6: Co-author declarations allowing use of published material in the thesis

KEMRI/ WELLCOME TRUST RESEARCH PROGRAMME
(Centre for Geographic Medicine Research – Coast)

P.O.Box 230, 80108, Kilifi, Kenya
Tel: (+254) 417 522535/522063/525044/525453
Fax: (+254) 417 522390
Email: info@kilifi.kemri-wellcome.org

P.O.Box 43640, 00100, Nairobi, Kenya
Tel: (+254) 20 2710672/2715160
Fax: (+254) 20 2711673
Email: info@nairobi.kemri-wellcome.org

1 February 2020

RE: INCLUSION OF CO-AUTHORED PUBLICATION MATERIAL IN THE PHD THESIS SUBMISSION FOR MEGHAN BRUCE KUMAR

To whom it may concern:

Meghan has my permission and full support to include our co-authored material in the body of her thesis.

Yours sincerely

Dr. Edwine Barasa

Director, Nairobi Programme, KEMRI-Wellcome Trust Research Programme

1 February 2020

RE: INCLUSION OF CO-AUTHORED PUBLICATION MATERIAL IN THE PHD THESIS SUBMISSION FOR MEGHAN BRUCE KUMAR

To whom it may concern:

Meghan has my permission and full support to include our co-authored material in the body of her thesis.

(signature)

Name: Dr Miriam Taegtmeyer
Position: Professor
Institution: Liverpool School of Tropical Medicine

6 February 2020

RE: INCLUSION OF CO-AUTHORED PUBLICATION MATERIAL IN THE PHD THESIS SUBMISSION FOR MEGHAN BRUCE KUMAR

To whom it may concern:

Meghan has my permission and full support to include our co-authored material in the body of her thesis.

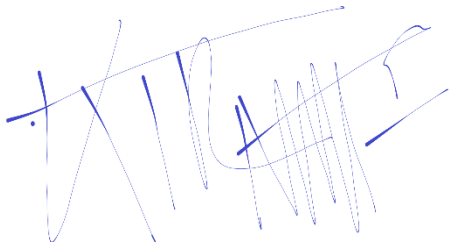
Name	Jason Madan
Position	Professor of Health Economics
Institution	Centre for Health Economics at Warwick, Warwick Medical School, University of Warwick

1 February 2020

RE: INCLUSION OF CO-AUTHORED PUBLICATION MATERIAL IN THE PHD THESIS SUBMISSION FOR MEGHAN BRUCE KUMAR

To whom it may concern:

Meghan has my permission and full support to include our co-authored material in the body of her thesis.



Name: Kingsley Rex Chikaphupha
Position: Research Coordinator
Institution: Research for Equity and Community Health (REACH) Trust, Malawi

1 February 2020

RE: INCLUSION OF CO-AUTHORED PUBLICATION MATERIAL IN THE PHD THESIS SUBMISSION FOR MEGHAN BRUCE KUMAR

To whom it may concern:

Meghan has my permission and full support to include our co-authored material in the body of her thesis.

Sozinho Ndima
Assistant Lecture and Researcher
Faculty of Medicine - University Eduardo Mondlane

1 February 2020

To whom it may concern

RE: INCLUSION OF CO-AUTHORED PUBLICATION MATERIAL IN THE PHD THESIS SUBMISSION FOR MEGHAN BRUCE KUMAR

Meghan has my permission and full support to include our co-authored material in the body of her thesis.

Maryline Mireku
Research Officer
LVCT Health

1 February 2020

RE: INCLUSION OF CO-AUTHORED PUBLICATION MATERIAL IN THE PHD THESIS SUBMISSION FOR MEGHAN BRUCE KUMAR

To whom it may concern:

Meghan has my permission and full support to include our co-authored material in the body of her thesis.

Dr Lilian Otiso
Executive Director

5 February 2020

RE: INCLUSION OF CO-AUTHORED PUBLICATION MATERIAL IN THE PHD THESIS SUBMISSION FOR MEGHAN BRUCE KUMAR

To whom it may concern:

Meghan has my permission and full support to include our co-authored material in the body of her thesis.

Name Peter Auguste
Position Research Fellow in health economics
Institution Warwick Medical School, University of Warwick

6 February 2020

RE: INCLUSION OF CO-AUTHORED PUBLICATION MATERIAL IN THE PHD THESIS SUBMISSION FOR MEGHAN BRUCE KUMAR

To whom it may concern:

Meghan has my permission and full support to include our co-authored material in the body of her thesis.

Name Christian Bernard Ochieng
Position Strategic information Manager
Institution LVCT Health

1 February 2020

RE: INCLUSION OF CO-AUTHORED PUBLICATION MATERIAL IN THE PHD THESIS SUBMISSION FOR MEGHAN BRUCE KUMAR

To whom it may concern:

Meghan has my permission and full support to include our co-authored material in the body of her thesis.

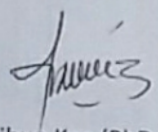
Name: Nelly M. Muturi
Position: Research Officer
Institution: LVCT Health

1 February 2020

RE: INCLUSION OF CO-AUTHORED PUBLICATION MATERIAL IN THE PHD THESIS SUBMISSION FOR MEGHAN BRUCE KUMAR

To whom it may concern:

Meghan has my permission and full support to include our co-authored material in the body of her thesis.



Aschenaki Zerihun Kea (PhD Student)

College of Medicine and Health Sciences, Hawassa University, Ethiopia

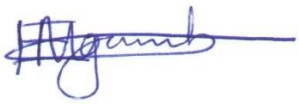
Center for International Health, University of Bergen, Norway

1 February 2020

RE: INCLUSION OF CO-AUTHORED PUBLICATION MATERIAL IN THE PHD THESIS SUBMISSION FOR MEGHAN BRUCE KUMAR

To whom it may concern:

Meghan has my permission and full support to include our co-authored material in the body of her thesis.



Elizabeth Mgamb
Director, Medical Servicers
Migori County

Appendix 7: Published Chapter 4 paper

BMJ Global Health

Is quality affordable for community health systems? Costs of integrating quality improvement into close-to-community health programmes in five low-income and middle-income countries

Meghan Bruce Kumar,[1,2] Jason J Madan,[3] Maryline Mireku Achieng,[4] Ralalicia Limato,[5] Sozinho Ndima,[6] Aschenaki Z Kea,[7] Kingsley Rex Chikaphupha,[8] Edwine Barasa,[9,10] Miriam Taegtmeyer[1]

To cite: Kumar MB, Madan JJ, Achieng MM, *et al*. Is quality affordable for community health systems? Costs of integrating quality improvement into close-to-community health programmes in five low-income and middle-income countries. *BMJ Global Health* 2019;**4**:e001390. doi:10.1136/bmjgh-2019-001390

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► Additional material is published online only. To view please visit the journal online (http://dx.doi.org/10.1136bmjgh-2019-001390).

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Revised 22 May 2019
Accepted 25 May 2019

For numbered affiliations see end of article.

Correspondence to
Meghan Bruce Kumar;
meghan.brucekumar@lstmed.ac.uk

ABSTRACT

Introduction Countries aspiring to universal health coverage view close-to-community (CTC) providers as a low-cost means of increasing coverage. However, due to lack of coordination and unreliable funding, the quality of large-scale CTC healthcare provision is highly variable and routine data about service quality are not trustworthy. Quality improvement (QI) approaches are a means of addressing these issues, yet neither the costs nor the budget impact of integrating QI approaches into CTC programme costs have been assessed.

Methods This paper examines the costs and budget impact of integrating QI into existing CTC health programmes in five countries (Ethiopia, Indonesia, Kenya, Malawi, Mozambique) between 2015 and 2017. The intervention involved: (1) QI team formation; (2) Phased training interspersed with supportive supervision; which resulted in (3) QI teams independently collecting and analysing data to conduct QI interventions. Project costs were collected using an ingredients approach from a health systems perspective. Based on project costs, costs of local adoption of the intervention were modelled under three implementation scenarios.

Results Annualised economic unit costs ranged from $62 in Mozambique to $254 in Ethiopia per CTC provider supervised, driven by the context, type of community health model and the intensity of the intervention. The budget impact of Ministry-led QI for community health is estimated at 0.53% or less of the general government expenditure on health in all countries (and below 0.03% in three of the five countries).

Conclusion CTC provision is a key component of healthcare delivery in many settings, so QI has huge potential impact. The impact is difficult to establish conclusively, but as a first step we have provided evidence to assess affordability of QI for community health. Further research is needed to assess whether QI can achieve the level of benefits that would justify the required investment.

Key questions

What is already known?

- The quality of close-to-community (CTC) healthcare services is highly variable and routine programme data are of poor quality.
- Quality of care provided by CTC providers can be improved through quality improvement (QI) approaches and measures.
- Stakeholders perceive QI approaches to be an additional and diversionary cost in resource-limited settings.

What are the new findings?

- Across the countries studied, capital costs of training are similar across implementation scenarios and represent a large proportion of the total cost of implementing QI approaches.
- Recurrent economic costs of QI per CTC provider range from $54 in Mozambique to $233 in Ethiopia, driven by costs of staff and volunteer time.
- The budget impact of national-scale QI for CTC programmes ranges from 0.03% to 0.58% of general government expenditure on health.

What do the new findings imply?

- Sustaining recurrent costs of QI for CTC programs is likely affordable within budget constraints if capital costs of training are supported.
- Systematic measuring of the benefits of QI on processes and outcomes should be a routine part of policy and practice to underpin investment decisions.

INTRODUCTION

Many governments struggling to achieve universal health coverage (UHC) in resource-poor settings are considering expanding healthcare coverage at low cost through the

use of close-to-community (CTC) providers of healthcare.[1–6] Composed of a wide range of typologies, CTC providers are lay health workers with relevant training for their responsibilities. They include: community health volunteers, community health (extension) workers, nutrition counsellors and traditional birth attendants, among others.[1 7] CTC providers deliver a range of preventive, promotive and curative healthcare services at community level depending on context and policy[5 8 9] and have been found to be effective in expanding service coverage in certain contexts and clinical areas.[10 11] However, CTC providers face numerous challenges working at the interface between communities and health systems due to factors such as: working remotely (where it can be difficult to maintain standards), lower literacy rates, higher attrition rates, less education and fewer support structures than other professional, formal cadres of healthcare workers more closely linked to the formal health sector.[9 12] Additionally, efforts to consider quality at the health system or global level continue to leave out CTC providers and ignore the potential contribution of the community level to health system goals.[13–15]

Despite the perception that CTC provision of care is 'cheap', economic evaluation of the work of CTC providers and programmes is complex due to a unique combination of challenges. First, costing involving this cadre is complicated by its composition of primarily part-time and/or volunteer workers (who may pay out-of-pocket costs that are difficult to measure for food or transport to support the effectiveness of the programmes).[16] Second, drawing generalisable conclusions is also difficult as the responsibilities, training, supervision and remuneration of CTC providers between (and even within) countries vary widely.[7 17] These challenges are not unique to CTC programmes, but this is an area where challenges are particularly numerous and acute. Additionally, cost-effectiveness studies rely on causal, proximal clinical outcomes to an intervention and high-quality data.[18 19] With community health, however, the long-term benefits of the primarily preventive and promotive services provided by CTC health workers are challenging to measure and to attribute[20–22] and the quality of the data on both costs and benefits are questionable.[23–26] Few studies and models to date have taken this complexity sufficiently into account to collect real life data on the full set of services, focusing instead on a limited set of services and/or heavily on modelling.[18 27 28]

Policy makers are beginning to question whether CTC providers can achieve equitable service quality at low cost.[29] Evidence is growing for systematically incorporating quality improvement (QI) approaches into community health programmes in low-income and middle-income countries, especially in maternal and child health.[30–34] These community-level approaches appear to have been successful in terms of improving the quality and equity of services, but there is limited information about costs or cost-effectiveness of implementation.[32 34] This lack of financial data acts as a barrier to decision makers, who may perceive the financial and time costs of incorporating QI approaches to be high when compared with the urgency of further expanding coverage while under pressure to show progress towards UHC.[35 36] We set out to examine the costs of integrating QI approaches in community health programmes at a mid-level of administration in Ethiopia, Indonesia, Kenya, Malawi, Mozambique—five countries with established community health programmes addressing maternal and/or child health among other priorities at CTC level through preventive and promotive care (table 1). This study is a first, essential step towards assessing the cost-effectiveness of this approach.

METHODS

We nested this costing within REACHOUT, a consortium of research partners in community health conducting an implementation research study addressing the feasibility and effectiveness of QI at community level.[37] While the CTC providers' typology and responsibilities varied across the countries, we used a common approach to QI team establishment and training. Based on actual project costs, we have then taken a scenario planning approach to assess the costs and budget impact of a long-term Ministry of Health (MoH)-led adoption of this approach by public sector staff in each setting. We report (in 2017USD): total and annualised economic costs per country; total and average annual financial costs of the intervention per country; for the MoH-led adoption, we report the same and add the unit economic and financial costs of intervention per: catchment population, CTC provider, QI team trained and administrative area. We also report the budget impact of national scale-up of MoH-led QI.

The intervention

QI capacity development efforts were guided by a common approach across the study countries, as shown in figure 1. In all settings, after curriculum development and adaptation of the training materials, QI teams made up of CTC providers, supervisors and health facility staff (average eight people) were established. In Kenya and Ethiopia, project team and MoH partners decided in step 3 to form QI teams at both the community and the district levels. These teams were trained in three phases to conduct QI for community health using Plan-Do-Study-Act (PDSA) cycles. PDSA approaches are characterised by local selection, prioritisation and action on quality problems identified from local data.[38–42] Training content included: standards for quality in community health, quality assurance and QI concepts, community health information systems, supportive supervision, and so on. The three phases of training and exchange (implemented over 9–12 months) were interspersed with periods of implementation of QI by the teams, involving team meetings and interventions to improve quality supported by mentorship from supervisors, with

Table 1 Intervention sites for quality improvement (QI) capacity development intervention[47 48 80–84]

Country *Region*	Administrative unit (district or equivalent)	QI teams	Setting	Catchment population	CTC providers	# of CTC providers supervised	Focus of CTC programme	Policy ratio of CTC providers to population
Ethiopia *Southern Nations, Nationalities and Peoples' Region, Sidama Zone*	Shebedino *woreda**	1 Community QI team at *woreda** level 9 Community QI teams covering health centre catchments: Abela health centre Galuko-hirreye health centre Gebre-kirstos health centre Mero kawado health centre Telamo health centre Fura health centre Dobe toga health centre Morocho negasha health centre Dulacha health centre	Rural, medium-remote	244 489	Health extension workers	68	Preventive, curative, family planning	2:5000
Indonesia *Cianjur district*	Cianjur district	4 Community QI teams covering three *puskesmas*† Cikalongkulon *Pukesmas*† Ciranjang 1 *Pukesmas*† Ciranjang 2 *Pukesmas*† Gekbrong *Pukesmas*†	Suburban, medium-remote	188 323	*Puskesmas* midwives	47	Maternal health (including delivery)	~1:5000–6000 general population (but serve women)
Kenya *Nairobi county*	Embakasi West subcounty Kasarani subcounty Lang'ata subcounty	3 Community QI teams at subcounty 9 Community QI teams covering community units: Maili Saba Unit Bangladesh Unit Southlands Unit Raila Unit Gitari Marigu Unit Housing Development Dept Unit City Carton Unit Matopeni Unit Ribakia Unit	Urban, non-remote	737 460	Community health volunteers Community health extension workers	1530	Preventive	1:500 1:2500
Malawi	Mchinji, Salima districts	2 Community QI teams at district level	Rural, remote	213 206	Health surveillance assistants	121	Preventive, curative	1:1000
Mozambique *Maputo province*	Manhiça, Moamba districts	2 Community QI teams at district level	Rural, non-remote	214 388	Agentes polivalentes elementares	68	Preventive, curative	~1:500–2000

**Woreda* is the Amharic word for district, at the level below Zone in the Ethiopian health system.
†*Puskesmas* is the Bahasa word for community health facility.
CTC, close-to-community.

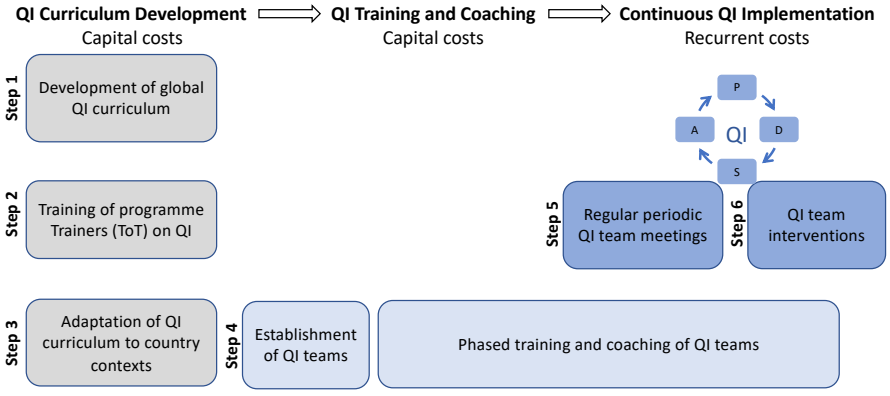

Figure 1 Common approach to capacity development for quality improvement (QI) for close-to-community (CTC) healthcare across countries.

the expectation that implementation could be continued indefinitely in what is termed 'continuous QI'. Examples of QI priorities tackled include: improving timeliness of reporting by CTC providers; improving follow-up of pregnant women referred for antenatal care; reducing rates of unskilled delivery. These priorities were selected and improvement was measured by the teams using local community health information systems and data.

Study site selection

The common approach to QI in community health was implemented with 21 QI teams in 11 administrative areas of the five countries serving a total of 1.6 million people in their catchment areas. In each country, study sites were selected for the QI intervention in collaboration with stakeholders from the community and MoH building on earlier supportive supervision interventions for the CTC programme (see table 1). Further description of the CTC provider typologies in each of the study sites including selection, training and responsibilities can be found in Supplementary File 1.[43]

Costing approach

The costing took a health systems perspective, taking into account health system resource and time costs (we differentiate that from health system costs, as CTC providers may not be salaried individuals whose time is explicitly valued by the health system).[44 45] Specifically, we collected and report both economic and financial costs of the intervention, as well as the budget impact of national scale-up based on the financial costs only. Financial costs refer to outlay of money; economic costs encompass financial costs and opportunity costs of time, even where people are already salaried or are volunteers and their time is 'free'. An ingredients approach was used to assess the costs of each phase of the intervention in the following categories: staff time (encompasses volunteer time), lodging/ transport, communication, venue, refreshment, stationery.[46] In our model, costs incurred during the training are treated as capital costs while the QI implementation represents recurrent costs of the intervention. The useful life of the training is taken as 4 years (ie, all participating staff would receive full retraining in year 5). Details of specific cost adjustments made at each of the steps of the intervention when calculating country costs can be found in Supplementary File 2.

Data on the actual costs in local currency of QI capacity development and functioning were collected retrospectively (March–July 2017) from country research teams using a combination of structured questionnaire on activities and a spreadsheet for unit resource costs (Supplementary Files 3 and 4). Project costings for consumables were calculated by multiplying units of resources consumed by market rates in May 2017. For other categories, that is, salaries, venue, transport, communication, actual project expenses incurred were used. Data were provided by implementation and finance team members from each REACHOUT country partner institution and validity of data was confirmed through back-checking financial reporting and audited information. Salaries for the public sector staff involved in intervention activities were obtained from public documents referenced here; where not available they were estimated from available data.[47–52] Where available, actual value of employment benefits were used. Where not available, an assumption of 15% of salary was applied. We excluded outcome-related costs, for example, costs averted due to improved health, as outside the scope of the study.

Annual costs are reported in 2017USD and exchange rates from May 2017 were used.[53] For details of cost adjustments made at each of the steps of the intervention when calculating country costs, see Supplementary File 2. (NB country costs cannot be added together to compute the actual total project cost due to these adjustments). A discount rate of 3% was applied to future costs; because

inflation was only relevant to the development (sunk) costs, this is not accounted for in the model. Data were input and managed in Microsoft Excel V.15.32.

Scenario planning and sensitivity analysis

Based on project costing, we present three scenarios for adoption of the intervention in each country, which we term 'MoH-led QI'. These scenarios assume the interventions were to be repeated across the same administrative area and population as the project-led approach. Specifically, we present the economic costs of MoH-led QI per administrative area of the intervention (table 1) by step of the intervention (figure 1). Where multiple levels of QI teams were involved (ie, in Kenya and Ethiopia), we have included costs for both and described this as increased intensity of intervention.

All scenarios for MoH-led QI involved the following modifications to the project costs: (1) dropping all development costs as sunk costs incurred by REACHOUT (steps 1–3); (2) health system staff acting as trainers (step 4); and (3) periodic mentorship at quarterly QI team meetings (step 5). Deterministic sensitivity analyses were conducted around 'best' case and 'worst' case scenarios for MoH-led QI, based on the level of involvement required of project staff in the scale-up and the frequency of QI team meetings and interventions (Supplementary File 5 for details).

Budget impact analysis

Budget impact analysis was conducted by comparing the financial costs of MoH-led QI, scaled up linearly to national level based on the total number of administrative areas in the country, with the annual general government expenditure on health (GGHE). GGHE was chosen as a comparator for the budget impact analysis for two reasons: first, financing for community QI is unlikely to be a repurposing of community/preventive care budgets. In part, this is due to the reliance on unpaid or low-paid staff in current community/preventive care budgets, making this a misleading comparison (in addition to the variability in pay levels for CTC providers between contexts). Also, what is proposed is a systemic change to the health system, given how CTC providers are used (across a broad spectrum of health areas) and could be supported by general government funding. The argument is for government investment, so need to compare with GGHE. Second, as community/preventive care budgets are often not earmarked in externally available documents, using these as the basis of budget impact analysis would require us to estimate a percentage of GGHE rather than relying on empirical data. Specific analyses for each health system or even budget-holding unit with more granular data would still be required for ultimate financing decisions—this analysis is indicative of broader trends in investment in community health systems and quality across systems.

GGHE data were obtained from the National Health Accounts database (on 6 October 2017)[54] and inflated from 2014USD (the most recent year to have complete data) to 2017USD,[55] assuming no change in expenditure over these 3 years as GGHE as a portion of total government expenditure has remained constant for some time. We have not included salaries of public sector staff as financial costs in the budget impact analysis because no additional staff were hired to conduct the QI activities.

Ethical approval

Country research activities described herein were governed under national approvals; details available in Supplementary File 6.

Patient and public involvement

Co-development of research questions in the wider REACHOUT sproject was done with relevant government counterparts and community health stakeholders in each country; patients were not directly involved in any way. Results will be disseminated to participants through technical working groups in each country as relevant.

RESULTS

Total costs of project-led QI intervention

The economic costs of developing the intervention, establishing and training 29 QI teams, and mentoring those teams through one completed QI cycle were incurred across the 11 administrative areas in the five countries as part of the REACHOUT project. These ranged from $11 351.32 (Mozambique) to $333 589.89 (Kenya) and show the full costs of the dedicated technical project teams, curriculum development and training. When aggregated across countries, costs of conducting the three phases of training made up about 70% of the total costs and were driven largely by people-time and by the intensive, phased nature of the training. Training costs varied widely between the five countries and were greatest in Kenya at $267 111 (where the highest number (12) of teams were trained), and were least in Indonesia at $3868, where the project team limited costs of this phase through use of available public sector venues. The total recurrent costs of implementation across countries (incurred in QI team meetings and QI interventions) were similar to development costs in year 1 (15%–16% of the total costs).

Total costs of MoH adoption of QI intervention

When MoH-led adoption of the QI approach is modelled for the same sites, the economic costs per administrative district are less than the project-incurred costs in each country, showing that unit costs of the intervention were higher for the project than those that would be faced by local decision makers. The annualised economic costs range from $4250.07 in Mozambique to $102 339.98 in Kenya (see table 2 for details of country costs). In sites where teams deliberately selected or prioritised QI problems that could be solved at low cost without additional project funding, the capital costs of training (incurred in year 1) represent a larger percentage of the total spend. Ethiopian and Malawian project teams provided

Table 2 Financial and economic costs of Ministry of Health-led quality improvement for community health in each country (2017USD)

Country	Financial costs			Unit annual financial costs per:					Economic costs			Unit annualised economic cost per:				
	Capital costs of training	Annual recurrent costs	Average annual cost	Administrative area	QI team trained	QI team member	CTC provider supervised	Capita	Capital costs of training	Annual recurrent costs	Annualised cost	Administrative area	QI team trained	QI team member	CTC provider supervised	Capita
Ethiopia	8509.25	9034.92	11 324.13	11 324.13	1258.24	179.75	166.53	0.05	12 326.54	13 959.67	17 275.84	17 275.84	1919.54	274.22	254.06	0.07
Indonesia	2008.98	62.15	602.62	200.87	150.65	20.78	12.82	0.00	3371.14	6536.81	7443.74	2481.25	1860.94	256.68	158.38	0.03
Kenya	84 853.87	16 938.84	39 766.82	13 255.61	3313.90	414.24	25.99	0.05	259 211.01	32 605.21	102 339.98	34 113.33	8528.33	1066.04	66.89	0.14
Malawi	4878.76	4316.62	5629.14	2814.57	2814.57	201.04	46.52	0.03	9210.99	8932.05	11 410.06	5705.03	5705.03	407.50	94.30	0.05
Mozambique	4963.79	588.03	1923.42	961.71	961.71	83.63	28.29	0.01	7001.19	2366.56	4250.07	2125.03	2125.03	184.79	62.50	0.02

CTC, close-to community; QI, quality improvement.

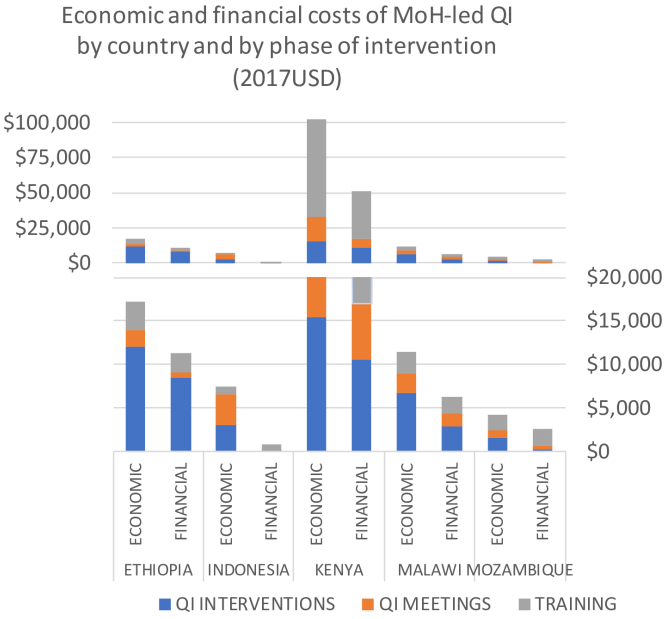

Figure 2 Annualised economic costs and average annual financial costs of Ministry of Health (MoH)-led quality improvement (QI) (by country and by step; 2017USD).

additional external 'project funds' to the QI teams when developing QI interventions (to cover items such as venue for refresher training of CTC providers, transportation for QI team to visit field facility sites and test new tools), which increased implementation costs. The average annual financial costs are lower in all sites than the annualised economic costs, as expected (figure 2). This is because a QI approach to community health requires an ongoing investment of time from existing staff in the form of trainings and meetings.

The overall costs of MoH-led QI show high intercountry variability (figure 2), in part due to the differences in the sites (table 1) in terms of geography, population density and the wage differential. In Kenya and Ethiopia where two levels of QI teams were formed, the impact on cost is demonstrated in a high resource-level difference in both sites, as well as a high unit cost per CTC provider supervised in Ethiopia and a high unit cost per QI team member trained in Kenya.

Based on the scenarios described in Supplementary File 5, active adoption (ie, greater ownership by public sector staff in training and more frequent QI interventions) drove up the annualised economic costs in each country by 7%–21% while more passive adoption led to decreased costs of 67%–92% of the base case values, with the greatest variability observed in Indonesia and Malawi (Supplementary File 7). Training, which is a relatively static cost across scenarios, represented a smaller proportion of the costs in these two sites, increasing sensitivity to the different levels of activity in the intervention phase.

Unit costs of MoH-led QI for community health

As shown in table 2, the costs of MoH-led QI per capita are between <0.01–0.5 (financial) and 0.02–0.14 (economic). The annualised economic costs per administrative area

are between $2125 (Mozambique) and $34 113 (Kenya). Despite that variation, the annualised economic costs per CTC provider supervised are much closer, ranging from $62 (Mozambique) to $254 (Ethiopia). Mozambique presents the lowest economic costs overall and economic unit costs in all cases except per QI team trained, for which unit costs in Indonesia and Ethiopia are lowest (table 2). The average financial cost per CTC provider supervised ranges from $12 in Indonesia to $166 in Ethiopia.

In both Ethiopia and Kenya, the intensity of the intervention was much greater, involving formation of two levels: district-equivalent QI teams and community QI teams. Ethiopia was the most expensive site in which to embed the intervention across the key indicators of cost per CTC provider supervised. The number of health extension workers in Shebedino *woreda* is almost equivalent to the number of QI team members, so these unit costs appear very close. The Ethiopian costs are dominated by the cost-heavy intervention that was chosen by the woreda (district) community QI team, which was a 4-day refresher training exercise. In Nairobi, the site of the Kenyan intervention and the other outlier due to cost, high density of both CTC providers and population make it appear high cost at the administrative unit level, yet more affordable at these more granular unit levels (table 2). Mozambique had the least expensive intervention in terms of absolute costs and this remained true across all indicators. Indonesia, as the only Asian context, was the least expensive site to conduct the intervention financially, showing similar cost structures and constraints despite very different geography and health system structures.

Budget impact of MoH-led QI for community health

Annual government spending on health ranged from $15–16 per capita in Ethiopia and Malawi to $49 per capita in Kenya, whereas the annualised financial costs of MoH-led QI is between <$0.01 to $0.05 per capita. Based on scaling up the average annual financial costs of the intervention per administrative district to nationwide coverage, the budget impact of MoH-led QI for community health represents less than 0.53% of the GGHE in all countries. The impact of MoH-led QI on annual government budgets varies somewhat by these levels of health expenditure, as Ethiopia has the lowest GGHE and the highest costs, so it shows the greatest budget impact, though still low (at 0.53%). In Kenya, the other study site that implemented 'two-level' community QI, budget impact of national-scale community QI is 0.16% of GGHE, and in the three other study countries the budget impact is 0.03% or less of GGHE. Also relevant to budgeting is the fact that the financial outlay would be greatest in year 1, when the training occurs, with low recurrent financial outlay; after annualisation this variation is masked.

DISCUSSION

Summary of findings

We found that the economic costs of integrating QI approaches into community health range from $62 to $254 per CTC provider, with the most expensive unit cost incurred in Ethiopia. Collecting costs was a complicated exercise across the countries and intercountry variability was high. The largest component of costs of our phased training model were capital costs of capacity development generated in the training portion of the intervention, out of which the biggest cost driver was the time of existing public sector staff. In sites reporting high financial outlays, these were driven in part by the selection of venues and trainers, as well as general higher cost of living particularly in Nairobi. Greater intensity of the intervention (ie, two levels of QI teams; more teams per administrative area) was correlated to higher costs, both economic and financial. In Ethiopia, Kenya and Malawi, QI interventions drove up costs as teams were provided additional financing to use for interventions rather than working within existing resources. Across settings, national scale-up of the approach would have a budget impact of between 0.02% and 0.03% (in Indonesia, Malawi, Mozambique) up to 0.16% (Kenya) and 0.53% (Ethiopia) relative to the GGHE.

Sustainability of the approach

Sustaining QI approaches (or 'MoH-led QI') for community health will depend on financial commitment to take on recurrent costs by the subnational administrative units and national decision makers. In Malawi, Kenya and Indonesia, study countries with some decentralisation of health financing allocation decisions, the district (or equivalent administrative) level management has indicated a commitment to allocate funds to cover the recurrent costs for the year following the end of the project-led intervention. This financial commitment would likely come from the general health budget rather than the community health or preventive care budget, which is misleading in its size—it relies on unpaid or underpaid staff, the specifics of which varies by country, as well as heavy external financing. Because this is a system-wide change to the health system, given that CTC providers are used across a broad range of health areas and are a cadre of human resources for health, the argument for government investment is beyond the community budget to the GGHE. Given the wide range of services offered and benefits of high-quality CTC care, a societal perspective might be optimal,[3 12 56 57] but benefits are beyond the scope of this study.

Despite the limited budget impact of this intervention, workload may be a challenge to the recurrent time costs. Time is a non-financial outlay, which is positive for the inclusion of the approach into local budgets going forward, although it may present challenges related to workload of mid-level health systems management staff. A reduction in meeting frequency may be feasible after the initial intensive start-up/mentorship phase of

implementation to reduce recurrent time costs as well as financial costs; in the base case, we used a quarterly frequency to reflect this (rather than the original monthly design). However, as Greenhalgh *et al* write, diffusion of effective innovations in high-functioning health service delivery organisations is a notorious challenge,[58] so it is likely to be a greater challenge where resources are limited.

The project-led intervention has been conducted on a pilot scale in each country, so it is not known whether these unit costs are similar at scale or whether economies of scale or scope might be achieved.[59] The use of budget impact analysis was an attempt to address affordability at scale.[60]

In looking at affordability of scale-up, the costs of the phased training and mentorship intrinsic to the intervention design as described are higher than a traditional one-off workshop training. Reduced costs for training might also be achieved by inclusion of the QI material into in-service training for CTC providers and supervisors. Another option is a one-time external investment to cover training costs that would then be sustained by leveraging domestic cofinancing for the recurrent costs.

Benefits of the QI approach can be difficult to capture

For policy makers and donors to be convinced by costing data, they must first be convinced of the benefits of what is being costed, and this has created a challenge for QI approaches generally. We have not presented data on the individual improvements achieved by the 29 improvement teams included in our study, which are similar to those observed by other community QI projects from several settings in sub-Saharan Africa.[31–34 61–65] Immediate process outcomes of the QI approach we used included: improved supervision and integration of the community health programme to the health system, consensus building across levels of the health system on priority problems and improved data quality on critical health service areas—all of which have been shown to support improved performance of CTC providers.[5 9 43 66 67] The health impacts of integrating QI are harder to attribute due to the complex, iterative and locally driven nature of the approach. Measuring and attributing the downstream benefits of a service delivery intervention that are intrinsically valuable to a decision maker or population is challenging.[20 68–72] Adding to the challenges of potential confounding, in 'Step Six' of the intervention (figure 1), QI teams have the freedom to design and test QI interventions to address locally relevant problems they select (in contrast to having a standard QI intervention imposed by higher-level or external stakeholders). These have greater potential to directly affect and yield benefits in priority health areas. However, this freedom or choice makes it challenging to evaluate outcomes systematically across intervention sites, as they are likely to be yielded in different health areas depending on the QI intervention selected by each QI team.

Community health services are often a low priority for domestic investment in health systems despite being shown to be cost-effective.[18 19 27 73] The interventions that are funded out of the health budget are more often those that are most visible (facilities, ambulances) or urgent and curative (tertiary care) that can show immediate impact and benefit to the politician, rather than those with longer-term population-wide benefits like community health and preventive services.[74] Where funded, the focus of investment in community health has been on increasing coverage towards UHC with limited emphasis on quality. Here we show that with a small additional investment, coverage of the population by CTC providers can potentially be transformed into meaningful coverage through improved performance and stronger linkages to higher-level healthcare services and providers.

For countries where this QI approach has been piloted through the REACHOUT project, the policy implications of affordability need to be contextualised beyond what is presented in the budget impact analysis here. Sub-national 'use cases' for adoption of this QI approach are being developed jointly with national policy makers. These cases will bring out multiple feasible locally relevant scenarios for adoption and scale-up of the approach, considering current staffing ratios, strategy development and budget cycles. Following on from discussions of affordability, assessment of whether QI for community health is a good investment requires a quantification of the benefits yielded by the intervention coupled with this cost analysis. To assess cost-effectiveness and relevance to UHC, further data on benefits derived from the intervention are required as well as an assessment of the reach of those benefits on the target population. Further, a qualitative exploration of decision space for the various funders of community health and their values in terms of benefits is planned to supplement the findings of this study, building on the abovementioned work by McCollum *et al*.[74]

Strengths and limitations of the study

Having robust, primary cost data collected and compared across countries and specifically looking at quality of care is very valuable, given the global focus on quality under UHC.[12 13 15 75 76] At the same time, a major limitation of this (any) intercountry analysis is the differences in contexts. Variations in health systems, administrative units, CTC provider tasks and typology (Supplementary File 1) were easier to identify and describe than aspects of hierarchy, expectations of training allowances, donor and project fatigue, but these less tangible aspects also affect the design and cost of getting a QI approach for community health to work. Nevertheless, findings around affordability and cost drivers were robust across contexts. We emphasised contextualisation of the intervention to each country, encouraging country teams to adapt while maintaining fidelity to the intervention design within a given set of restrictions.[77–79] In step 3 (figure 1), the intervention explicitly asked teams to adapt the global

curriculum as appropriate to their context, bringing in local trainers and approaches as well as modifying the composition of the QI teams to best reflect existing health system structure, management and reporting lines. This is most clearly exemplified by the varied intensity of the intervention in Ethiopia and Kenya as compared with the other three settings, in addition to minor modifications due to variations in health system structures and supervisory approaches.

Significant challenges were faced in three of the five countries to estimate the costs of participation of public sector staff (as trainees and facilitators) due to sensitivity around salary data. In Malawi, public sector salaries were not publicly available and we received confidential estimates from multiple sources in addition to the limited public reference data. In Indonesia, the range of salaries within each tier is wide, reflecting the years of service of the individual more strongly than their level of responsibility. In Kenya, public sector expenses for participation in trainings were split into several categories (per diem, dinner allowance, workshop sitting allowance, local transport allowance). These were additional to the costs of mobilisation (referring to the phoning and follow-up with supervisees to ensure attendance) and facilitation but not applicable to all, making the actual costs of participation in training difficult to calculate but possible to estimate. In contrast, in Ethiopia and Mozambique public sector staff salaries are publicly available and presented no difficulty. The sensitivity around salary information reflects both transparency by the government and cultural values related to money and privacy.

CONCLUSION

CTC providers are a key component of healthcare provision in many settings. QI for community health has the possibility of bringing CTC providers more definitively under the umbrella of human resources for health, better aligning community interests with the health system's work. By integrating QI into community health services, policy makers hope to ensure the quality of the services delivered is being measured and improved (where required), leading to increased demand-side confidence in and utilisation of these services. As a first step towards assessing whether QI for CTC healthcare services is affordable, we have provided a detailed breakdown of the costs of community-level QI. Further research is needed to assess whether this type of intervention can achieve the level of benefits required to justify this investment, as decision makers work towards the domestic and global goals of universal access to high-quality healthcare services.

Author affiliations
[1]Department of International Public Health, Liverpool School of Tropical Medicine, Liverpool, UK
[2]Center for Humanitarian Emergencies, Rollins School of Public Health, Emory University, Atlanta, Georgia, USA
[3]Warwick Medical School, University of Warwick, Coventry, UK
[4]Research and Strategic Information, LVCT Health, Nairobi, Kenya
[5]Eijkman-Oxford Clinical Research Unit, Eijkman Institute for Molecular Biology, Jakarta, Indonesia
[6]Community Health Department, University of Eduardo Mondlane, Faculty of Medicine, Maputo, Mozambique
[7]School of Public and Environmental Health, Hawassa University, Hawassa, Ethiopia
[8]Health Systems & HIV/AIDS Dept, Research for Equity and Community Health (REACH) Trust, Lilongwe, Malawi
[9]Health Economics Research Unit, KEMRI-Wellcome Trust Research Programme, Nairobi, Kenya
[10]Centre for Tropical Medicine, Nuffield Department of Clinical Medicine, Oxford University, Oxford, UK

Twitter @kumeghan

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Contributors Study design and measures: MBK, JJM, MT. Data collection, analysis, interpretation of results: MBK, AZK, SN, RL, MMA, KRC. Drafting of manuscript: MBK, JJM, EB, MT. Comments and revision of manuscript: all authors.

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Appendix 8: Supplementary material from published Chapter 4 paper

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Supplementary File 1: Key differences and similarities in CHW programme design features in 2015 in Ethiopia, Indonesia, Kenya, Malawi, Mozambique

Design Feature	Ethiopia		Kenya		Malawi		Mozambique	Indonesia		
General features										
Programme start	2004	2011	2006	2006	1992		1978; Revitalised 2010	1989 for village midwife (VMW), 1985 for kader, late 1960s for traditional birth attendant (TBA)		
Name of CTC provider	Health Extension Worker (HEW)	Health development army (HDA) leader	Community Health Extension Worker (CHEW)	Community Health Worker (CHW)	Health Surveillance Assistant (HSA)	Volunteer	*Agente Polivalente Elementar* (APE)	Village midwives	*Posyandu kaders* (Community Health Volunteer)	Traditional Birth Attendant (TBA)
Standing category	General CHW	Advocate or instructor	General CHW	General CHW	General CHW	Advocate or instructor	General CHW	Formal health provider	General CHW	Specialised CHW
Employment status (Gov/NGO)	Monthly, paid by the government	Volunteer	Government	Government/NGO	Government	NGO		Government	Community-based (community volunteer)	Self-employed
Programme focus area	Four major components, including 16 packages: disease prevention and control (HIV/AIDS, tuberculosis, malaria, first aid); family health (maternal and child health, family planning, immunization, nutrition, adolescent health); hygiene and environmental sanitation (excreta disposal, solid and liquid waste disposal,	Sensitization and community mobilization on HEP packages	Disease prevention and control, family health services and hygiene and environmental sanitation		Community health, family health, environmental health, prevention and control of communicable diseases and management and administration		Child health, diagnose and treat malaria, diarrhoea, chest infections	Maternal health: delivery care, antenatal and postnatal care	Weighing of infants, health promotion: nutrition advice and diarrhoea control	Previously, assisting in home deliveries. Now: partner with village midwives

Supplementary File 1: Key differences and similarities in CHW programme design features in 2015 in Ethiopia, Indonesia, Kenya, Malawi, Mozambique

Design Feature	Ethiopia		Kenya		Malawi		Mozambique	Indonesia		
	water supply and safety measures, food hygiene and safety measures, healthy home environment, control of insects and rodents, personal hygiene); health education and communication									
Working hours per week	40 hours	Not specified	Full time government employee; 8 hours/day, 5 days a week	Not specified; however, each CHV should visit all households allocated in a month	40hours	15-20hours a week (varied depending on the nature of the assignment given by different NGOs)		Officially, 10-12 hours but, they have to stand by at the village for 24 hours per day	Approx. 6 hours per month (3 – 4 hours during in the Posyandu services and 2-3 hours doing home visit). Working hours are expanded when there are national programmes like vitamin A, national immunisation program, etc.	24 hours uncertain
Catchment area covered	Every Health Post has two HEWs, serving average population of 5,000	30 and 5 households for health development team and one to five network leaders' respectively	5,000 population	20 households (or 100 population)	1,000 population	Variable but often not determined	2500 households	1- 3 villages 500-15006500 people	1 'RT' or second tier of the village	1 village across villages and even sub-district and district
M&E activities	Monitor the leaders' of	No	MoH tools: CHEW	MoH tools; Referral register	YES	NO		VMW report their activities	Kader report their activities	Not available

Supplementary File 1: Key differences and similarities in CHW programme design features in 2015 in Ethiopia, Indonesia, Kenya, Malawi, Mozambique

Design Feature	Ethiopia		Kenya		Malawi		Mozambique	Indonesia		
	HDAs and one to five network		summary (MoH 515), supervision of CHVs, Household Register summary	(MoH 100), Service Delivery Log book (MoH 514), Household register (MoH 513)				to the DHO through midwife coordinator and head of Puskesmas.	to the village midwives, to the 'kader Posyandu forum' and to the village head/head of PKK.	
Health service responsibilities	Curative, promotive and preventive services	Advocacy and sensitisation	Curative, promotive and preventive services. Six age cohorts – includes pregnant women	Mobilisation, referral, follow up, basic treatment	Essential health package, curative and preventive services, supervision of village health committees	Information, Education and Communication, growth monitoring, referrals to health facilities	Promotive and preventive services, limited curative services (80% and 20% respectively)	Antenatal care, point of care tests, postnatal care	Mobilisation and support	Partner with midwives
Selection and recruitment										
Gender	Female	Female and male	Male and female	Male and female	Male and female	Male and female	Male and female (71% male)	Female	Majority female	Majority Female
Selection criteria	Residence in the village, capacity to speak local language, completed 10th grade, and willingness to remain in the village and serve communities	Belonging to a model family, be able role model to others, having the trust of members, and being able to mobilize the community.	A certificate in one of the following areas: Community Health, Sociology, Nutrition, Psychology, Counselling, Social Work, Community Development	Respected and literate community resident, approachable and able to motivate others, good example in health and development, and willing to volunteer for five years	At least completed primary school, preferably secondary school	Willingness to volunteer	Being aged 18 or over, being a resident and active member of the community and well respected by fellow community members, having minimal literacy (able to read and write in Portuguese) and numeracy (able to perform basic arithmetic calculations). Preference was given to women candidates (although in practice more men are selected for reasons yet to be better studied).	Trained Midwives	Willingness to volunteer, literate	Traditionally in place
Recruitment process	Selection is done by a committee comprising members nominated by	Leaders of the health development teams and the one-to-five networks are	Trained health professionals	Committed local residents	Interviewed and recruited by government health system	Community selection process	Community selection process	Civil service scheme and 'PTT' scheme	Selection by the community, mostly elders/ head of village/head of community.	NA

Supplementary File 1: Key differences and similarities in CHW programme design features in 2015 in Ethiopia, Indonesia, Kenya, Malawi, Mozambique

Design Feature	Ethiopia		Kenya		Malawi		Mozambique	Indonesia		
	the local community and representatives from the woreda (district) health office, the woreda capacity-building office, and the woreda education office.	selected by their team members supported by the HEWs and kebele administration							Increasing involvement of village midwives in selection process.	
Training and supervision										
Supervision responsibilities	Supervise leaders' of HDA and one to five network	No	Oversight of CHWs	No	Oversight of volunteers	No	No	Oversight of volunteers	No	No
Initial training	1 year	Few days	Full professional training	10 days training	12 weeks training	None, ad hoc for campaigns or activities	Four months residential training	Nursing academy 3 years	None	Non-formal; through mentoring
Additional training	On-job training related to local interventions Upgrading to diploma level education	HEWs' packages focused updates	Five days training of trainers	Quarterly refresher updates	Ad hoc for campaigns of NGO activities	Ad hoc for campaigns of NGO activities	Ad hoc refreshers	In service training offered	On the job. Learning by doing	Through mentoring
Supervision structure	Supervised by supervisors from the Health Centre and *woreda* health office weekly and monthly respectively	Informal and irregular, by HEWs	Supervised by district focal person; at least once per month	Supervised by CHEWs in a 1-25 ratio; at least once per month	Supervised by Environmental Health Officers and Community Nurses Monthly/quarterly	Ad hoc by HSAs	Supervised by facility-based health care workers (monthly) and district (quarterly) and provincial supervisors (6 month). But irregular	Formally supervised by midwife coordinator at PHC Frequency: once a month	None by the head of village/head of PKK (once a month) and village midwife (after Posyandu service, but not applied in all Posyandu).	None
Remuneration and supplies										

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Supplementary File 1: Key differences and similarities in CHW programme design features in 2015 in Ethiopia, Indonesia, Kenya, Malawi, Mozambique

Design Feature	Ethiopia		Kenya		Malawi		Mozambique	Indonesia		
Salary	Yes	No	Yes	No	Yes	No	Yes (described as an allowance or subsidy)	Yes	No	No
Incentives from health system	Some programmes give airtime, allowance during in-service training Ad hoc best performance award from regional health bureau or ministry of health during HEWs festival	Ad hoc per diem when campaigns are conducted	Some programmes give airtime, motorbikes, bikes	Non-monetary e.g. bicycles, badges etc.	Some programmes give bikes, t-shirts, airtime	Some programmes give t-shirts or other goods	Uniforms, flashlight, backpack. Some programmes (from NGO) give airtime, bikes.	Transport; incentive per antenatal care, delivery assisted and postnatal care, from national insurance scheme, district and region insurance scheme	Allowance varying from 5-20 Euros per month. Incentives from various government and NGO heath programmes.	Gifts in kind, incentives for referral to facility delivery
Supplies	Basic Kit	Information, Education and Communication materials	Custodians of the kit	Basic kit	Uniform, weighing scale, Information, Education and Communication materials and others depending on district/ NGOs involved	None	Custodians of the kit that includes gloves, bandages, antibiotics, ORS, malaria tests and treatment	Midwifery kit, tests, training	Uniform, Information, Education (training) and Communication materials	Previously: delivery kit Now: None

Details of specific cost adjustments made at each of the steps of the intervention when calculating country costs. **NB Country costs cannot be added together to get a total project cost.**

These are detailed below by step of the intervention, as described in Figure 1 of the main paper.

Step #	Adjustment
1.	The curriculum development costs have been included in each of the country costings, though they were only incurred once.
2.	In order to achieve comparability between countries, in addition to the two international quality improvement expert trainers we have costed the participation of the minimum required country team: one senior researcher, one junior researcher, and one policymaker at the local rate for each country in the reference case. The venue cost used was a domestic venue relevant for each country, as identified by the teams.
3.	The country adaptation included the adaptation of materials internally to the trainer team as well as external alignment meetings where needed. Also, where relevant this included sensitisation of senior Ministry of Health officials on the approach through local meetings.
4.	Where applicable, costs associated with selection of participants for the training have also been included here along with actual training costs.
5.	Regardless of the actual meeting frequency when implemented by country QI teams, we have costed a quarterly meeting frequency for comparability.
6.	The QI interventions designed by the teams will generate economic costs and *may* generate financial costs. For 'resulting interventions', annualized costs were calculated based on the first resulting intervention attempted by each QI team, and assumes a functional QI team will implement two such interventions annually in the reference case.

To be filled out by each country's REACHOUT research team

A. Summary of the major steps of quality improvement (QI) intervention:
Check these inter-country steps and contextualize based on what you actually did as a country team. Is anything major missing? If so, add it in the list below and in the table in part B as a new line.

1. Training of trainers on QI
2. Adapt QI training material for your country
3. Identify QI teams
4. Training QI teams
5. Ongoing QI team meetings
6. QI team interventions

B. Activities that make up the steps
There are smaller activities that make up each of those big steps listed in Part A.
For example, there might be a sensitisation meeting required before nominating a QI team or liaising with potential attendees to fix a meeting time.
For each major step, try to include all the activities and quantify the resources that made it happen – the information in step 1 is provided as an example.
NB – you do not need to know the prices/costs of the consumables at this point!

	Venue (name and # of days)	People (#, role/title/grade, days)	Consumables (e.g. stationery, printing, food)	Transportation (vehicle type, distance – where possible)
STEP 1: Training of trainers on QI				
1-0: ID and confirm facilitators	LSTM office (no rental required)	1 senior PI – 0 days 1 consultant - .5 days 1 admin asst – 0.5 days		
1-1: Design curriculum	LSTM office (no rental required)	1 senior PI – 10 days 1 consultant – 10 days 3 senior researchers – 2 days each	6 pads of sticky notes 2 white boards 500 pages of printing 3 ring binders	
1-2: Travel to ToT venue		All REACHOUT researchers 2 trainers 3 policymakers		Flights to Jakarta Charter bus

1-3: Training of trainers	Indonesia hotel 3 days	All REACHOUT researchers 2 trainers 3 policymakers	300 pages printing Notebooks and pens Conference package	
STEP 2: Adapt country QI curriculum				
2-1:				
STEP 3: Nominate/select QI teams				
STEP 4: QI trainings				
Phase 1				
Phase 2				
Phase 3				
STEP 5: QI team meetings (Describe what would be required for a single meeting in the steps below and list the frequency (weekly/monthly/quarterly/etc:				
STEP 6: QI intervention				

What I'll do next: restructure then information you sent into Excel and send it back with you to discuss with your finance person (probably will require about 2 hours) to fill in the details!

This will be followed by a workshop in the Nairobi consortium meeting for further discussion of the differences between countries.

	item	# of units	unit cost	subtotal	Activity cost
Step 1: Development of global quality improvement curriculum					
	Curriculum devlopment materials			0	
	International QI experts			0	
	Venue			0	0
Step 2: Training of program trainers (ToT) on quality improvement					
	Venue			0	
	Conference package			0	
	Senior researcher			0	
	Junior researcher			0	
	Policymaker			0	
	International QI expert trainers			0	
	USB			0	0
Step 3a: Adaptation - Sensitisation of National and County MoH teams on QI					0
Sensitisation of national MoH team on QI				0	
				0	
				0	
				0	
				0	
				0	0
Sensitisation of county MoH team on QI				0	
				0	
				0	
				0	
				0	
				0	0
Sensitisation of sub-county HMT team on QI				0	
				0	
				0	
				0	
				0	
				0	0
Step 3b: Adaptation of QI curriculum to country context					0
National MoH meetings to discuss content				0	
				0	
				0	
				0	
				0	
				0	
				0	
				0	0
National MoH workshops to draft QI curriculum				0	
				0	
				0	
				0	
				0	
				0	
				0	
				0	
				0	0
Internal meetings to draft content				0	
				0	
				0	
				0	0
Skype calls to discuss content				0	
				0	
				0	0
Internal one week workshop to finalize training content				0	
				0	
				0	
				0	
				0	0
Pilot of QI tools					
Step 4: Nominate/select QI teams					0
Consultation with Sub County Health Management Teams				0	
				0	
				0	
				0	
				0	
				0	
				0	0
Step 5: QI tranings					0
Phase 1 training: QI orientation				0	
				0	
				0	
				0	
				0	
				0	0

Phase 2 training: capacity building on data analysis				0	
				0	
				0	
				0	
				0	0
Phase 3 training: presentation of data and evaluation				0	
				0	
				0	
				0	
				0	
				0	0
Step 6: QI team meetings					
Quarterly QI team meetings (multiplied by 4 to get annual cost)					
					0
Step 7: QI intervention on data quality					0
CHV training on completion of data tools				0	
				0	
				0	
				0	
				0	
				0	
				0	
				0	
				0	
				0	
				0	0
Provision of MoH data tools				0	0
Training of QI coaches				0	
				0	
				0	
				0	
				0	
				0	
				0	
				0	
				0	
				0	
				0	0
QI coaching by researchers				0	
				0	
				0	
				0	
				0	
				0	
				0	
				0	
				0	
				0	0
Supporting QI coaching by MoH officials				0	0

Intervention step number* and description	Sensitivity cases		
	Reference case	**Active adoption**	**Poor adoption**
Step 4: Establishment and training of QI teams	Two public sector trainers One REACHOUT master trainer	Public sector trainers only	Two REACHOUT master trainers One public sector support trainer
Step 5: QI team meetings	Quarterly meetings Annual supervision by MoH supervisors	Quarterly meetings Biannual supervision by MoH supervisors	Bi-annual meetings No supervision
Step 6: QI team interventions	Two interventions per year	Two interventions per year	One intervention per year

*refers to steps from the diagram shown in Figure 1 of the main document.

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Supplementary file 6: In country ethical review boards and approvals

Study country	Ethical Review Board	Protocol Reference Number
Ethiopia	Southern Nations Nationalities and People's Regional State Health Bureau	ሀጤ 2-8/1754
Indonesia	University of Hasanuddin	597/H4.8.4.5.31/PP36-KOMETIK/2016
Kenya	Kenya Medical Research Institute	KEMRI/RES/7/3/1
Malawi	National Health Sciences Research Committee	1286
Mozambique	University of Eduardo Mondlane, Faculty of Medicine and Central Hospital of Maputo	CIBS FM&HCM/45/2014
United Kingdom	University of Liverpool, Liverpool School of Tropical Medicine	14.007

ETHIOPIA **ECONOMIC**

Scenario: **Embedded base case economic costs**

Item	Cost per item	Year 1	Year 2	Year 3	Year 4	Year 5	**Total 5 year costs**	Annualized
Training	$ 12,326.54	$ 3,316.17	$ 3,316.17	$ 3,316.17	$ 3,316.17	$ 3,316.17	$ 16,580.86	$ 3,316.17
QI meetings	$ 1,897.42	$ 1,897.42	$ 1,897.42	$ 1,897.42	$ 1,897.42	$ 1,897.42	$ 9,487.12	$ 1,897.42
QI interventions	$ 12,062.24	$12,062.24	$12,062.24	$12,062.24	$12,062.24	$12,062.24	$ 60,311.21	$12,062.24
Total							$ 86,379.19	$17,275.84

Scenario: **Embedded active case economic costs**

Item	Cost per item	Year 1	Year 2	Year 3	Year 4	Year 5	**Total 5 year costs**	Annualized
Training	$ 11,839.00	$ 3,185.01	$ 3,185.01	$ 3,185.01	$ 3,185.01	$ 3,185.01	$ 15,925.06	$ 3,185.01
QI meetings	$ 1,897.42	$ 1,897.42	$ 1,897.42	$ 1,897.42	$ 1,897.42	$ 1,897.42	$ 9,487.12	$ 1,897.42
QI interventions	$ 16,082.99	$16,082.99	$16,082.99	$16,082.99	$16,082.99	$16,082.99	$ 80,414.94	$16,082.99
Total							$ 105,827.12	$21,165.42

Scenario: **Embedded passive case economic costs**

Item	Cost per item	Year 1	Year 2	Year 3	Year 4	Year 5	**Total 5 year costs**	Annualized
Training	$ 12,814.07	$ 3,447.33	$ 3,447.33	$ 3,447.33	$ 3,447.33	$ 3,447.33	$ 17,236.66	$ 3,447.33
QI meetings	$ 948.71	$ 948.71	$ 948.71	$ 948.71	$ 948.71	$ 948.71	$ 4,743.56	$ 948.71
QI interventions	$ 8,440.13	$ 8,440.13	$ 8,440.13	$ 8,440.13	$ 8,440.13	$ 8,440.13	$ 42,200.67	$ 8,440.13
Total							$ 64,180.89	$12,836.18

FINANCIAL

Embedded base case financial costs

Item	Cost per item	Year 1	Year 2	Year 3	Year 4	Year 5	**Total 5 year costs**	Average costs
Training	$ 8,509.25	$ 2,289.22	$ 2,289.22	$ 2,289.22	$ 2,289.22	$ 2,289.22	$ 11,446.09	$ 2,289.22
QI meetings	$ 539.80	$ 539.80	$ 539.80	$ 539.80	$ 539.80	$ 539.80	$ 2,699.01	$ 539.80
QI interventions	$ 8,495.11	$ 8,495.11	$ 8,495.11	$ 8,495.11	$ 8,495.11	$ 8,495.11	$ 42,475.57	$ 8,495.11
Total							$ 56,620.66	$11,324.13

Embedded active case financial costs

Item	Cost per item	Year 1	Year 2	Year 3	Year 4	Year 5	**Total 5 year costs**	Average costs
Training	$ 8,021.71	$ 2,158.06	$ 2,158.06	$ 2,158.06	$ 2,158.06	$ 2,158.06	$ 10,790.29	$ 2,158.06
QI meetings	$ 539.80	$ 539.80	$ 539.80	$ 539.80	$ 539.80	$ 539.80	$ 2,699.01	$ 539.80
QI interventions	$11,326.82	$11,326.82	$11,326.82	$11,326.82	$11,326.82	$11,326.82	$ 56,634.09	$11,326.82
Total							$ 70,123.38	$14,024.68

Embedded passive case financial costs

Item	Cost per item	Year 1	Year 2	Year 3	Year 4	Year 5	**Total 5 year costs**	Average costs
Training	$ 8,996.78	$ 2,420.38	$ 2,420.38	$ 2,420.38	$ 2,420.38	$ 2,420.38	$ 12,101.89	$ 2,420.38
QI meetings	$ 269.90	$ 269.90	$ 269.90	$ 269.90	$ 269.90	$ 269.90	$ 1,349.50	$ 269.90
QI interventions	$ 6,062.05	$ 6,062.05	$ 6,062.05	$ 6,062.05	$ 6,062.05	$ 6,062.05	$ 30,310.24	$ 6,062.05
Total							$ 43,761.63	$ 8,752.33

INDONESIA **ECONOMIC**

Scenario: **Embedded base case economic costs**

Item	Cost per item	Year 1	Year 2	Year 3	Year 4	Year 5	**Total 5 year costs**	Annualized
Training	$ 3,371.14	$ 906.93	$ 906.93	$ 906.93	$ 906.93	$ 906.93	$ 4,534.64	$ 906.93
QI meetings	$ 3,584.55	$ 3,584.55	$ 3,584.55	$ 3,584.55	$ 3,584.55	$ 3,584.55	$ 17,922.77	$ 3,584.55
QI interventions	$ 2,952.26	$ 2,952.26	$ 2,952.26	$ 2,952.26	$ 2,952.26	$ 2,952.26	$ 14,761.29	$ 2,952.26
Total							$ 37,218.70	$ 7,443.74

Scenario: **Embedded active case economic costs**

Item	Cost per item	Year 1	Year 2	Year 3	Year 4	Year 5	**Total 5 year costs**	Annualized
Training	$ 3,312.35	$ 891.11	$ 891.11	$ 891.11	$ 891.11	$ 891.11	$ 4,455.56	$ 891.11
QI meetings	$ 3,647.27	$ 3,647.27	$ 3,647.27	$ 3,647.27	$ 3,647.27	$ 3,647.27	$ 18,236.34	$ 3,647.27
QI interventions	$ 3,936.34	$ 3,936.34	$ 3,936.34	$ 3,936.34	$ 3,936.34	$ 3,936.34	$ 19,681.72	$ 3,936.34
Total							$ 42,373.63	$ 8,474.73

Scenario: **Embedded passive case economic costs**

Item	Cost per item	Year 1	Year 2	Year 3	Year 4	Year 5	**Total 5 year costs**	Annualized
Training	$ 3,414.93	$ 918.71	$ 918.71	$ 918.71	$ 918.71	$ 918.71	$ 4,593.54	$ 918.71
QI meetings	$ 948.71	$ 948.71	$ 948.71	$ 948.71	$ 948.71	$ 948.71	$ 4,743.56	$ 948.71
QI interventions	$ 1,968.17	$ 1,968.17	$ 1,968.17	$ 1,968.17	$ 1,968.17	$ 1,968.17	$ 9,840.86	$ 1,968.17
Total							$ 19,177.97	$ 3,835.59

FINANCIAL

Embedded base case financial costs

Item	Cost per item	Year 1	Year 2	Year 3	Year 4	Year 5	**Total 5 year costs**	Average costs
Training	$ 2,008.98	$ 540.47	$ 540.47	$ 540.47	$ 540.47	$ 540.47	$ 2,702.35	$ 540.47
QI meetings	$ 59.99	$ 59.99	$ 59.99	$ 59.99	$ 59.99	$ 59.99	$ 299.94	$ 59.99
QI interventions	$ 2.16	$ 2.16	$ 2.16	$ 2.16	$ 2.16	$ 2.16	$ 10.80	$ 2.16
Total							$ 3,013.08	$ 602.62

Embedded active case financial costs

Item	Cost per item	Year 1	Year 2	Year 3	Year 4	Year 5	**Total 5 year costs**	Average costs
Training	$ 1,479.83	$ 398.11	$ 398.11	$ 398.11	$ 398.11	$ 398.11	$ 1,990.57	$ 398.11
QI meetings	$ 59.99	$ 59.99	$ 59.99	$ 59.99	$ 59.99	$ 59.99	$ 299.94	$ 59.99
QI interventions	$ 2.88	$ 2.88	$ 2.88	$ 2.88	$ 2.88	$ 2.88	$ 14.40	$ 2.88
Total							$ 2,304.91	$ 460.98

Embedded passive case financial costs

Item	Cost per item	Year 1	Year 2	Year 3	Year 4	Year 5	**Total 5 year costs**	Average costs
Training	$ 2,052.77	$ 552.25	$ 552.25	$ 552.25	$ 552.25	$ 552.25	$ 2,761.25	$ 552.25
QI meetings	$ 29.99	$ 29.99	$ 29.99	$ 29.99	$ 29.99	$ 29.99	$ 149.97	$ 29.99
QI interventions	$ 1.44	$ 1.44	$ 1.44	$ 1.44	$ 1.44	$ 1.44	$ 7.20	$ 1.44
Total							$ 2,918.42	$ 583.68

KENYA **ECONOMIC**

Scenario: **Embedded base case economic costs**

Item	Cost per item	Year 1	Year 2	Year 3	Year 4	Year 5	**Total 5 year costs**	Annualized
Training	$ 259,211.01	$69,734.77	$69,734.77	$69,734.77	$69,734.77	$69,734.77	$ 348,673.86	$69,734.77
QI meetings	$ 17,212.08	$17,212.08	$17,212.08	$17,212.08	$17,212.08	$17,212.08	$ 86,060.41	$17,212.08
QI interventions	$ 15,393.13	$15,393.13	$15,393.13	$15,393.13	$15,393.13	$15,393.13	$ 76,965.64	$15,393.13
Total							$ 511,699.90	###########

Scenario: **Embedded active case economic costs**

Item	Cost per item	Year 1	Year 2	Year 3	Year 4	Year 5	**Total 5 year costs**	Annualized
Training	$ 275,324.47	$74,069.73	$74,069.73	$74,069.73	$74,069.73	$74,069.73	$ 370,348.65	$74,069.73
QI meetings	$ 19,617.58	$19,617.58	$19,617.58	$19,617.58	$19,617.58	$19,617.58	$ 98,087.89	$19,617.58
QI interventions	$ 20,524.17	$20,524.17	$20,524.17	$20,524.17	$20,524.17	$20,524.17	$ 102,620.85	$20,524.17
Total							$ 571,057.39	###########

Scenario: **Embedded passive case economic costs**

Item	Cost per item	Year 1	Year 2	Year 3	Year 4	Year 5	**Total 5 year costs**	Annualized
Training	$ 260,755.95	$70,150.40	$70,150.40	$70,150.40	$70,150.40	$70,150.40	$ 350,752.02	$70,150.40
QI meetings	$ 7,403.29	$ 7,403.29	$ 7,403.29	$ 7,403.29	$ 7,403.29	$ 7,403.29	$ 37,016.46	$ 7,403.29
QI interventions	$ 10,262.09	$10,262.09	$10,262.09	$10,262.09	$10,262.09	$10,262.09	$ 51,310.43	$10,262.09
Total							$ 439,078.90	$87,815.78

FINANCIAL

Embedded base case financial costs

Item	Cost per item	Year 1	Year 2	Year 3	Year 4	Year 5	**Total 5 year costs**	Average costs
Training	$84,853.87	$22,827.99	$22,827.99	$22,827.99	$22,827.99	$22,827.99	$ 114,139.93	$22,827.99
QI meetings	$ 6,412.11	$ 6,412.11	$ 6,412.11	$ 6,412.11	$ 6,412.11	$ 6,412.11	$ 32,060.54	$ 6,412.11
QI interventions	$10,526.73	$10,526.73	$10,526.73	$10,526.73	$10,526.73	$10,526.73	$ 52,633.64	$10,526.73
Total							$ 198,834.12	$39,766.82

Embedded active case financial costs

Item	Cost per item	Year 1	Year 2	Year 3	Year 4	Year 5	**Total 5 year costs**	Average costs
Training	$83,667.71	$22,508.88	$22,508.88	$22,508.88	$22,508.88	$22,508.88	$ 112,544.39	$22,508.88
QI meetings	$ 6,550.02	$ 6,550.02	$ 6,550.02	$ 6,550.02	$ 6,550.02	$ 6,550.02	$ 32,750.11	$ 6,550.02
QI interventions	$11,942.07	$11,942.07	$11,942.07	$11,942.07	$11,942.07	$11,942.07	$ 59,710.35	$11,942.07
Total							$ 205,004.85	$41,000.97

Embedded passive case financial costs

Item	Cost per item	Year 1	Year 2	Year 3	Year 4	Year 5	**Total 5 year costs**	Average costs
Training	$88,040.98	$23,685.40	$23,685.40	$23,685.40	$23,685.40	$23,685.40	$ 118,427.02	$23,685.40
QI meetings	$ 3,137.10	$ 3,137.10	$ 3,137.10	$ 3,137.10	$ 3,137.10	$ 3,137.10	$ 15,685.49	$ 3,137.10
QI interventions	$ 7,017.82	$ 7,017.82	$ 7,017.82	$ 7,017.82	$ 7,017.82	$ 7,017.82	$ 35,089.10	$ 7,017.82
Total							$ 169,201.61	$33,840.32

MALAWI **ECONOMIC**

Scenario: **Embedded base case economic costs**

Item	Cost per item	Year 1	Year 2	Year 3	Year 4	Year 5	**Total 5 year costs**	Annualized
Training	$ 9,210.99	$ 2,478.00	$ 2,478.00	$ 2,478.00	$ 2,478.00	$ 2,478.00	$ 12,390.02	$ 2,478.00
QI meetings	$ 2,177.52	$ 2,177.52	$ 2,177.52	$ 2,177.52	$ 2,177.52	$ 2,177.52	$ 10,887.58	$ 2,177.52
QI interventions	$ 6,754.54	$ 6,754.54	$ 6,754.54	$ 6,754.54	$ 6,754.54	$ 6,754.54	$ 33,772.68	$ 6,754.54
Total							$ 57,050.28	$ 11,410.06

Scenario: **Embedded active case economic costs**

Item	Cost per item	Year 1	Year 2	Year 3	Year 4	Year 5	**Total 5 year costs**	Annualized
Training	$ 8,492.33	$ 2,284.67	$ 2,284.67	$ 2,284.67	$ 2,284.67	$ 2,284.67	$ 11,423.33	$ 2,284.67
QI meetings	$ 2,177.52	$ 2,177.52	$ 2,177.52	$ 2,177.52	$ 2,177.52	$ 2,177.52	$ 10,887.58	$ 2,177.52
QI interventions	$ 9,006.05	$ 9,006.05	$ 9,006.05	$ 9,006.05	$ 9,006.05	$ 9,006.05	$ 45,030.24	$ 9,006.05
Total							$ 67,341.15	$ 13,468.23

Scenario: **Embedded passive case economic costs**

Item	Cost per item	Year 1	Year 2	Year 3	Year 4	Year 5	**Total 5 year costs**	Annualized
Training	$ 9,248.58	$ 2,488.12	$ 2,488.12	$ 2,488.12	$ 2,488.12	$ 2,488.12	$ 12,440.59	$ 2,488.12
QI meetings	$ 1,088.76	$ 1,088.76	$ 1,088.76	$ 1,088.76	$ 1,088.76	$ 1,088.76	$ 5,443.79	$ 1,088.76
QI interventions	$ 4,503.02	$ 4,503.02	$ 4,503.02	$ 4,503.02	$ 4,503.02	$ 4,503.02	$ 22,515.12	$ 4,503.02
Total							$ 40,399.50	$ 8,079.90

FINANCIAL

Embedded base case financial costs

Item	Cost per item	Year 1	Year 2	Year 3	Year 4	Year 5	**Total 5 year costs**	Average costs
Training	$ 4,878.76	$ 1,312.52	$ 1,312.52	$ 1,312.52	$ 1,312.52	$ 1,312.52	$ 6,562.60	$ 1,312.52
QI meetings	$ 1,391.11	$ 1,391.11	$ 1,391.11	$ 1,391.11	$ 1,391.11	$ 1,391.11	$ 6,955.56	$ 1,391.11
QI interventions	$ 2,925.51	$ 2,925.51	$ 2,925.51	$ 2,925.51	$ 2,925.51	$ 2,925.51	$ 14,627.53	$ 2,925.51
Total							$ 28,145.69	$ 5,629.14

Embedded active case financial costs

Item	Cost per item	Year 1	Year 2	Year 3	Year 4	Year 5	**Total 5 year costs**	Average costs
Training	$ 5,211.81	$ 1,402.12	$ 1,402.12	$ 1,402.12	$ 1,402.12	$ 1,402.12	$ 7,010.59	$ 1,402.12
QI meetings	$ 1,391.11	$ 1,391.11	$ 1,391.11	$ 1,391.11	$ 1,391.11	$ 1,391.11	$ 6,955.56	$ 1,391.11
QI interventions	$ 3,900.67	$ 3,900.67	$ 3,900.67	$ 3,900.67	$ 3,900.67	$ 3,900.67	$ 19,503.37	$ 3,900.67
Total							$ 33,469.53	$ 6,693.91

Embedded passive case financial costs

Item	Cost per item	Year 1	Year 2	Year 3	Year 4	Year 5	**Total 5 year costs**	Average costs
Training	$ 5,743.02	$ 1,545.03	$ 1,545.03	$ 1,545.03	$ 1,545.03	$ 1,545.03	$ 7,725.14	$ 1,545.03
QI meetings	$ 695.56	$ 695.56	$ 695.56	$ 695.56	$ 695.56	$ 695.56	$ 3,477.78	$ 695.56
QI interventions	$ 1,950.34	$ 1,950.34	$ 1,950.34	$ 1,950.34	$ 1,950.34	$ 1,950.34	$ 9,751.69	$ 1,950.34
Total							$ 20,954.60	$ 4,190.92

MOZAMBIQUE **ECONOMIC**

Scenario: **Embedded base case economic costs**

Item	Cost per item	Year 1	Year 2	Year 3	Year 4	Year 5	**Total 5 year costs**	Annualized
Training	$ 7,001.19	$ 1,883.51	$ 1,883.51	$ 1,883.51	$ 1,883.51	$ 1,883.51	$ 9,417.54	$ 1,883.51
QI meetings	$ 750.26	$ 750.26	$ 750.26	$ 750.26	$ 750.26	$ 750.26	$ 3,751.28	$ 750.26
QI interventions	$ 1,616.30	$ 1,616.30	$ 1,616.30	$ 1,616.30	$ 1,616.30	$ 1,616.30	$ 8,081.51	$ 1,616.30
Total							$ 21,250.33	$ 4,250.07

Scenario: **Embedded active case economic costs**

Item	Cost per item	Year 1	Year 2	Year 3	Year 4	Year 5	**Total 5 year costs**	Annualized
Training	$ 5,992.04	$ 1,612.02	$ 1,612.02	$ 1,612.02	$ 1,612.02	$ 1,612.02	$ 8,060.11	$ 1,612.02
QI meetings	$ 769.08	$ 769.08	$ 769.08	$ 769.08	$ 769.08	$ 769.08	$ 3,845.39	$ 769.08
QI interventions	$ 2,155.07	$ 2,155.07	$ 2,155.07	$ 2,155.07	$ 2,155.07	$ 2,155.07	$ 10,775.34	$ 2,155.07
Total							$ 22,680.84	$ 4,536.17

Scenario: **Embedded passive case economic costs**

Item	Cost per item	Year 1	Year 2	Year 3	Year 4	Year 5	**Total 5 year costs**	Annualized
Training	$ 7,882.12	$ 2,120.50	$ 2,120.50	$ 2,120.50	$ 2,120.50	$ 2,120.50	$ 10,602.52	$ 2,120.50
QI meetings	$ 365.72	$ 365.72	$ 365.72	$ 365.72	$ 365.72	$ 365.72	$ 1,828.58	$ 365.72
QI interventions	$ 1,077.53	$ 1,077.53	$ 1,077.53	$ 1,077.53	$ 1,077.53	$ 1,077.53	$ 5,387.67	$ 1,077.53
Total							$ 17,818.77	$ 3,563.75

FINANCIAL

Embedded base case financial costs

Item	Cost per item	Year 1	Year 2	Year 3	Year 4	Year 5	**Total 5 year costs**	Average costs
Training	$ 4,963.79	$ 1,335.39	$ 1,335.39	$ 1,335.39	$ 1,335.39	$ 1,335.39	$ 6,676.97	$ 1,335.39
QI meetings	$ 370.99	$ 370.99	$ 370.99	$ 370.99	$ 370.99	$ 370.99	$ 1,854.97	$ 370.99
QI interventions	$ 217.03	$ 217.03	$ 217.03	$ 217.03	$ 217.03	$ 217.03	$ 1,085.16	$ 217.03
Total							$ 9,617.10	$ 1,923.42

Embedded active case financial costs

Item	Cost per item	Year 1	Year 2	Year 3	Year 4	Year 5	**Total 5 year costs**	Average costs
Training	$ 4,024.75	$ 1,082.77	$ 1,082.77	$ 1,082.77	$ 1,082.77	$ 1,082.77	$ 5,413.84	$ 1,082.77
QI meetings	$ 370.99	$ 370.99	$ 370.99	$ 370.99	$ 370.99	$ 370.99	$ 1,854.97	$ 370.99
QI interventions	$ 289.38	$ 289.38	$ 289.38	$ 289.38	$ 289.38	$ 289.38	$ 1,446.88	$ 289.38
Total							$ 8,715.69	$ 1,743.14

Embedded passive case financial costs

Item	Cost per item	Year 1	Year 2	Year 3	Year 4	Year 5	**Total 5 year costs**	Average costs
Training	$ 6,110.77	$ 1,643.96	$ 1,643.96	$ 1,643.96	$ 1,643.96	$ 1,643.96	$ 8,219.81	$ 1,643.96
QI meetings	$ 185.50	$ 185.50	$ 185.50	$ 185.50	$ 185.50	$ 185.50	$ 927.49	$ 185.50
QI interventions	$ 144.69	$ 144.69	$ 144.69	$ 144.69	$ 144.69	$ 144.69	$ 723.44	$ 144.69
Total							$ 9,870.73	$ 1,974.15

CHEERS checklist—Items to include when reporting economic evaluations of health interventions

Section/item	Item No	Recommendation	Reported on page No/ line No
Title and abstract			
Title	1	Identify the study as an economic evaluation or use more specific terms such as "cost-effectiveness analysis", and describe the interventions compared.	1/1
Abstract	2	Provide a structured summary of objectives, perspective, setting, methods (including study design and inputs), results (including base case and uncertainty analyses), and conclusions.	3
Introduction			
Background and objectives	3	Provide an explicit statement of the broader context for the study.	5 para 1-3
		Present the study question and its relevance for health policy or practice decisions.	5 para 5
Methods			
Target population and subgroups	4	Describe characteristics of the base case population and subgroups analysed, including why they were chosen.	9 para 3
Setting and location	5	State relevant aspects of the system(s) in which the decision(s) need(s) to be made.	5 para 2
Study perspective	6	Describe the perspective of the study and relate this to the costs being evaluated.	6 para 3
Comparators	7	Describe the interventions or strategies being compared and state why they were chosen.	6 para 3
Time horizon	8	State the time horizon(s) over which costs and consequences are being evaluated and say why appropriate.	6 para 3
Discount rate	9	Report the choice of discount rate(s) used for costs and outcomes and say why appropriate.	6 para 3
Choice of health outcomes	10	Describe what outcomes were used as the measure(s) of benefit in the evaluation and their relevance for the type of analysis performed.	6 para 5, 9 para 2
Measurement of effectiveness	11a	*Single study-based estimates:* Describe fully the design features of the single effectiveness study and why the single study was a sufficient source of clinical effectiveness data.	Not applicable
	11b	*Synthesis-based estimates*: Describe fully the methods used for identification of included studies and synthesis of clinical effectiveness data.	9 para 2 10 para 1
Measurement and valuation of preference based outcomes	12	If applicable, describe the population and methods used to elicit preferences for outcomes.	Not applicable
Estimating resources and costs	13a	*Single study-based economic evaluation:* Describe approaches used to estimate resource use associated with the alternative interventions. Describe primary or secondary research methods for valuing each resource item in terms of its unit cost. Describe any adjustments made to approximate to opportunity costs.	
	13b	*Model-based economic evaluation:* Describe approaches and data sources used to estimate	9 para 1 10 para 1

Section/item	Item No	Recommendation	Reported on page No/ line No
		resource use associated with model health states. Describe primary or secondary research methods for valuing each resource item in terms of its unit cost. Describe any adjustments made to approximate to opportunity costs.	
Currency, price date, and conversion	14	Report the dates of the estimated resource quantities and unit costs. Describe methods for adjusting estimated unit costs to the year of reported costs if necessary. Describe methods for converting costs into a common currency base and the exchange rate.	9 para 1
Choice of model	15	Describe and give reasons for the specific type of decision-analytical model used. Providing a figure to show model structure is strongly recommended.	6 para 4-5 Figure 1A and 1B
Assumptions	16	Describe all structural or other assumptions underpinning the decision-analytical model.	9 para 2 10 para 4-5
Analytical methods	17	Describe all analytical methods supporting the evaluation. This could include methods for dealing with skewed, missing, or censored data; extrapolation methods; methods for pooling data; approaches to validate or make adjustments (such as half cycle corrections) to a model; and methods for handling population heterogeneity and uncertainty.	Not applicable
Results			
Study parameters	18	Report the values, ranges, references, and, if used, probability distributions for all parameters. Report reasons or sources for distributions used to represent uncertainty where appropriate. Providing a table to show the input values is strongly recommended.	10 para 1 Table 1
Incremental costs and outcomes	19	For each intervention, report mean values for the main categories of estimated costs and outcomes of interest, as well as mean differences between the comparator groups. If applicable, report incremental cost-effectiveness ratios.	19 para 1-3 Table 2
Characterising uncertainty	20a	*Single study-based economic evaluation:* Describe the effects of sampling uncertainty for the estimated incremental cost and incremental effectiveness parameters, together with the impact of methodological assumptions (such as discount rate, study perspective).	
	20b	*Model-based economic evaluation:* Describe the effects on the results of uncertainty for all input parameters, and uncertainty related to the structure of the model and assumptions.	19 para 4-5 Figure 2 Supplementary Mat. 3
Characterising heterogeneity	21	If applicable, report differences in costs, outcomes, or cost-effectiveness that can be explained by variations between subgroups of patients with different baseline characteristics or other observed variability in effects that are not reducible by more information.	Not applicable
Discussion			
Study findings, limitations, generalisability, and current knowledge	22	Summarise key study findings and describe how they support the conclusions reached. Discuss limitations and the generalisability of the findings and how the findings fit with current knowledge.	21 – 24 Figure 3
Other			

Section/item	Item No	Recommendation	Reported on page No/ line No
Source of funding	23	Describe how the study was funded and the role of the funder in the identification, design, conduct, and reporting of the analysis. Describe other non-monetary sources of support.	1-2
Conflicts of interest	24	Describe any potential for conflict of interest of study contributors in accordance with journal policy. In the absence of a journal policy, we recommend authors comply with International Committee of Medical Journal Editors recommendations.	1

For consistency, the CHEERS statement checklist format is based on the format of the CONSORT statement checklist

Appendix 9: Aggregated supplementary material from submitted Chapter 5 paper

CHEERS checklist—Items to include when reporting economic evaluations of health interventions

Section/item	Item No	Recommendation	Reported on page No/ line No
Title and abstract			
Title	1	Identify the study as an economic evaluation or use more specific terms such as "cost-effectiveness analysis", and describe the interventions compared.	1/1
Abstract	2	Provide a structured summary of objectives, perspective, setting, methods (including study design and inputs), results (including base case and uncertainty analyses), and conclusions.	3
Introduction			
Background and objectives	3	Provide an explicit statement of the broader context for the study.	5 para 1-3
		Present the study question and its relevance for health policy or practice decisions.	5 para 5
Methods			
Target population and subgroups	4	Describe characteristics of the base case population and subgroups analysed, including why they were chosen.	9 para 3
Setting and location	5	State relevant aspects of the system(s) in which the decision(s) need(s) to be made.	5 para 2
Study perspective	6	Describe the perspective of the study and relate this to the costs being evaluated.	6 para 3
Comparators	7	Describe the interventions or strategies being compared and state why they were chosen.	6 para 3
Time horizon	8	State the time horizon(s) over which costs and consequences are being evaluated and say why appropriate.	6 para 3
Discount rate	9	Report the choice of discount rate(s) used for costs and outcomes and say why appropriate.	6 para 3
Choice of health outcomes	10	Describe what outcomes were used as the measure(s) of benefit in the evaluation and their relevance for the type of analysis performed.	6 para 5, 9 para 2
Measurement of effectiveness	11a	*Single study-based estimates:* Describe fully the design features of the single effectiveness study and why the single study was a sufficient source of clinical effectiveness data.	Not applicable
	11b	*Synthesis-based estimates*: Describe fully the methods used for identification of included studies and synthesis of clinical effectiveness data.	9 para 2 10 para 1
Measurement and valuation of preference based outcomes	12	If applicable, describe the population and methods used to elicit preferences for outcomes.	Not applicable
Estimating resources and costs	13a	*Single study-based economic evaluation:* Describe approaches used to estimate resource use associated with the alternative interventions. Describe primary or secondary research methods for valuing each resource item in terms of its unit cost. Describe any adjustments made to approximate to opportunity costs.	
	13b	*Model-based economic evaluation:* Describe approaches and data sources used to estimate	9 para 1 10 para 1

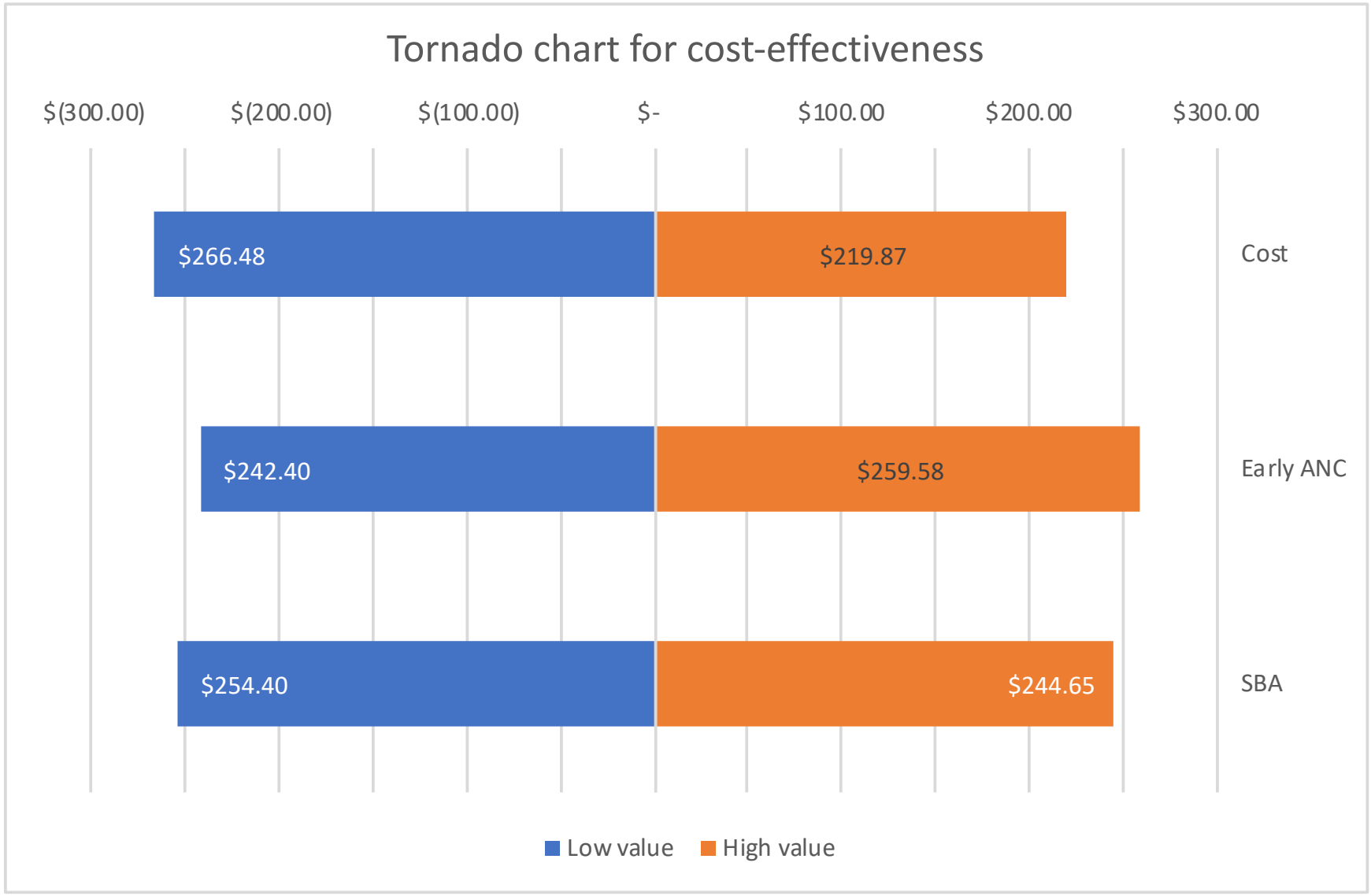
Section/item	Item No	Recommendation	Reported on page No/ line No
		resource use associated with model health states. Describe primary or secondary research methods for valuing each resource item in terms of its unit cost. Describe any adjustments made to approximate to opportunity costs.	
Currency, price date, and conversion	14	Report the dates of the estimated resource quantities and unit costs. Describe methods for adjusting estimated unit costs to the year of reported costs if necessary. Describe methods for converting costs into a common currency base and the exchange rate.	9 para 1
Choice of model	15	Describe and give reasons for the specific type of decision-analytical model used. Providing a figure to show model structure is strongly recommended.	6 para 4-5 Figure 1A and 1B
Assumptions	16	Describe all structural or other assumptions underpinning the decision-analytical model.	9 para 2 10 para 4-5
Analytical methods	17	Describe all analytical methods supporting the evaluation. This could include methods for dealing with skewed, missing, or censored data; extrapolation methods; methods for pooling data; approaches to validate or make adjustments (such as half cycle corrections) to a model; and methods for handling population heterogeneity and uncertainty.	Not applicable
Results			
Study parameters	18	Report the values, ranges, references, and, if used, probability distributions for all parameters. Report reasons or sources for distributions used to represent uncertainty where appropriate. Providing a table to show the input values is strongly recommended.	10 para 1 Table 1
Incremental costs and outcomes	19	For each intervention, report mean values for the main categories of estimated costs and outcomes of interest, as well as mean differences between the comparator groups. If applicable, report incremental cost-effectiveness ratios.	19 para 1-3 Table 2
Characterising uncertainty	20a	*Single study-based economic evaluation:* Describe the effects of sampling uncertainty for the estimated incremental cost and incremental effectiveness parameters, together with the impact of methodological assumptions (such as discount rate, study perspective).	
	20b	*Model-based economic evaluation:* Describe the effects on the results of uncertainty for all input parameters, and uncertainty related to the structure of the model and assumptions.	19 para 4-5 Figure 2 Supplementary Mat. 3
Characterising heterogeneity	21	If applicable, report differences in costs, outcomes, or cost-effectiveness that can be explained by variations between subgroups of patients with different baseline characteristics or other observed variability in effects that are not reducible by more information.	Not applicable
Discussion			
Study findings, limitations, generalisability, and current knowledge	22	Summarise key study findings and describe how they support the conclusions reached. Discuss limitations and the generalisability of the findings and how the findings fit with current knowledge.	21 – 24 Figure 3
Other			

Section/item	Item No	Recommendation	Reported on page No/ line No
Source of funding	23	Describe how the study was funded and the role of the funder in the identification, design, conduct, and reporting of the analysis. Describe other non-monetary sources of support.	1-2
Conflicts of interest	24	Describe any potential for conflict of interest of study contributors in accordance with journal policy. In the absence of a journal policy, we recommend authors comply with International Committee of Medical Journal Editors recommendations.	1

For consistency, the CHEERS statement checklist format is based on the format of the CONSORT statement checklist

Appendix 9, Supplementary File 2

Probabilistic Sensitivity Analysis full results available in Excel at this link: https://www.dropbox.com/s/45bbvn5kgsig8zq/Supplementary%20file%202_PSA%20outputs.xlsx?dl=0


Tornado chart for cost-effectiveness
$(300.00)
$(200.00)
$(100.00)
$-
$100.00
$200.00
$300.00
$266.48
$219.87
Cost
$242.40
$259.58
Early ANC
$254.40
$244.65
SBA
Low value
High value

Appendix 10: Published Chapter 6 paper

Health Policy and Planning, 2020, 1–11
doi: 10.1093/heapol/czaa027
Original Article

How do decision-makers use evidence in community health policy and financing decisions? A qualitative study and conceptual framework in four African countries

Meghan Bruce Kumar [1,2], Miriam Taegtmeyer[1,3,*], Jason Madan[4], Sozinho Ndima[5], Kingsley Chikaphupha[6], Aschenaki Kea[7,8] and Edwine Barasa[9,10]

[1]Community Health Systems Group, Department of International Public Health, Liverpool School of Tropical Medicine, Liverpool, UK, [2]MARCH Centre, London School of Hygiene and Tropical Medicine, London, UK, [3]Tropical Infectious Disease Unit, Royal Liverpool University Hospital, Liverpool, UK, [4]Centre for Health Economics at Warwick, Warwick Medical School, University of Warwick, Coventry, UK, [5]Community Health Department, Faculty of Medicine, University Eduardo Mondlane, Maputo, Mozambique, [6]Research for Equity and Community Health (REACH) Trust, Lilongwe, Malawi, [7]School of Public and Environmental Health, Hawassa University, Hawassa, Ethiopia, [8]Center for International Health, University of Bergen, Bergen, Norway, [9]Health Economics Research Unit, KEMRI-Wellcome Trust Research Programme, Nairobi, Kenya and [10]Centre for Tropical Medicine, Nuffield Department of Clinical Medicine, University of Oxford, Oxford, UK

*Corresponding author. Community Health Systems Group, Department of International Public Health, Liverpool School of Tropical Medicine, Pembroke Place, Liverpool L3 5QA, UK. E-mail: miriam.taegtmeyer@lstmed.ac.uk

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Abstract

Various investments could help countries deliver on the universal health coverage (UHC) goals set by the global community; community health is a pillar of many national strategies towards UHC. Yet despite resource mobilization towards this end, little is known about the potential costs and value of these investments, as well as how evidence on the same would be used in related decisions. This qualitative study was conducted to understand the use of evidence in policy and financing decisions for large-scale community health programmes in low- and middle-income countries. Through key informant interviews with 43 respondents in countries with community health embedded in national UHC strategies (Ethiopia, Kenya, Malawi, Mozambique) and at global institutions, we investigated evidence use in community health financing and policy decision-making, as well as evidentiary needs related to community health data for decision-making. We found that evidence use is limited at all levels, in part due to a perceived lack of high-quality, relevant evidence. This perception stems from two main areas: first, desire for local evidence that reflects the context, and second, much existing economic evidence does not deal with what decision-makers value when it comes to community health systems—i.e. coverage and (to a lesser extent) quality. Beyond the evidence gap, there is limited capacity to assess and use the evidence. Elected officials also face political challenges to disinvestment as well as structural obstacles to evidence use, including the outsized influence of donor priorities. Evaluation data must to speak to decision-maker interests and constraints more directly, alongside financiers of community health providing explicit guidance and support on the role of evidence use in decision-making, empowering national

decision-makers. Improved data quality, increased relevance of evidence and capacity for evidence use can drive improved efficiency of financing and evidence-based policymaking.

Keywords: Economic evaluation, community health, evidence-based policy, health financing, Ethiopia, Kenya, Malawi, Mozambique

Key Messages

- The use of evidence in national community health policy and financing decisions is limited by its perceived poor quality and the capacity of decision-makers to use it.
- Most existing evidence is perceived as of limited relevance to domestic decision-making; it is used more by global financiers of community health.
- Decision-makers emphasize increasing coverage of or access to services community health services—quality is rarely mentioned as a funding priority.
- Stopping an established approach to community health (disinvesting) in favour of another more economically viable approach is seen as politically challenging even when evidence exists.

Introduction

Well-resourced close-to-community (CTC) health workers can deliver high-quality care; there is extensive, robust, project- and trial-based evidence for this across a range of settings and disease areas, as shown in a set of recent reviews of community health programmes (Chou *et al.*, 2017; Freeman *et al.*, 2017; Jennings *et al.*, 2017; Perry *et al.*, 2017; Sacks *et al.*, 2017; Schleiff *et al.*, 2017; Scott *et al.*, 2018). Armed with this evidence, extending access to primary health care through CTC cadres with an aim of universal health coverage (UHC) has long been used as an approach and lately becomes a priority in many countries (Wang *et al.*, 2016; Bhutta, 2017; Javanparast *et al.*, 2018). The World Health Organization has supported operationalization of extending access in this way through the development of guidelines for national CTC programmes (Cometto *et al.*, 2018). Yet in many health systems, community health remains perceived as an extension of the 'formal' system rather than a core, integrated service delivery platform (Theobald *et al.*, 2015; Schneider and Lehmann, 2016; Tseng *et al.*, 2019).

Economic evidence should play a predominant role in the integration of community health into wider health systems, due to the need for trade-offs between different health investments and competition for limited resources. There is a small but growing body of economic evidence on community health programmes, recently presented in a systematic review by Nkonki *et al.*; like the evidence on quality described above, the authors state that most evidence is 'from small scale and vertical programmes' (Nkonki, Tugendhaft and Hofman, 2017). Once community health programmes start operating at scale, quality of care and performance of CTC providers do not always live up to their potential (Kok *et al.*, 2015; Silva *et al.*, 2016; Yourkavitch *et al.*, 2016; Ballard *et al.*, 2017; Phiri *et al.*, 2017; Lehmann *et al.*, 2019). The limited economic evaluations of the quality of large-scale CTC programmes generate uncertainty about the value of this investment; studies on the costs of large-scale CTC programmes (Vaughan *et al.*, 2015; Barger *et al.*, 2017; Daviaud *et al.*, 2017; Nkonki *et al.*, 2017; Taylor *et al.*, 2017) have rarely incorporated data on the quality of care. In assessing outcomes, incorporating quality into economic evaluations of CTC programmes is challenging because of difficulty in defining the quality of care for CTC interventions and the complex causal pathways between CTC quality of care measures and health outcomes. Poor data quality affects measurement across both costs and outcomes (Yourkavitch *et al.*, 2016; Regeru *et al.*, 2020).

As an extension or even marginalized aspect of the healthcare system, community health decision-making does not benefit from the many formal procedures for generating and using evidence that have been developed in the wider health sector. For example, there is a gap in community-focused financing literature; Scott *et al.* showed that, out of 122 publications on the ASHA programme in India between 2005 and 2016, only five dealt with financing (Scott *et al.*, 2019). Where it exists, community financing literature often focuses more on community-based micro insurance schemes rather than macro financing of community health programmes, despite a predominance of external financing in this space (McCollum *et al.*, 2018c; Agarwal *et al.*, 2019). Because potential users of evidence often perceive community-level care as 'free' to the system, this limits the commissioning of economic evidence at local and national levels. Similarly, in the wider sector, the broad literature on proceduralism focuses on formalized processes for evidence use, consultation and transparency (Barasa *et al.*, 2015)—yet in community health as a sub-sector, these processes are not well established. As such, even when evidence about community health interventions is available, this evidence may be underutilized in decision-making. In the absence of sufficient procedures (the largely external), investment in community health seems to be driven by ideology and global movements over evidence. A closer look specifically at community health decisions within the health sector is imperative given the relative marginalization of community health as an extension of the health system and its reliance on external financing in many low- and middle-income countries (LMICs) (Theobald *et al.*, 2015; Javanparast *et al.*, 2018; Tseng *et al.*, 2019).

This multi-country qualitative study was designed to understand the role of evidence in how decisions are made for community health financing and policy at national and global levels. We focus our study in four countries (Ethiopia, Kenya, Malawi, Mozambique) that have large-scale public sector community health programmes that remain highly dependent on external financing. In key informant interviews with national and global funders, policymakers and

researchers, we set out to understand what evidence is used and by whom, and when and what additional evidence could improve the efficiency of community health decision-making in settings where CTC providers are an integral part of the health system.

Methods

We used a qualitative cross-sectional approach to understand the use of economic evaluation evidence in community health priority setting and financing. Qualitative methods were utilized to allow for an understanding of the process (how things are currently working), stakeholders (who is involved) and wider decision space (role of the health system and context). Given the limited number of individuals involved in policy and financing decisions and their seniority, key informant interviews were selected as the most appropriate methodology to extract relevant information. Data were collected between November 2017 and November 2018.

Study sites and sampling

Forty three key informant interviews were conducted with purposively sampled decision-makers involved in community health policy and financing decisions at national and global levels based on the sampling frame shown in Table 1. We selected countries with national community health programmes in Africa that were part of the REACHOUT consortium: Kenya, Ethiopia, Malawi and Mozambique[1] (REACHOUT, 2013). Respondents included national and sub-national Ministry of Health staff involved with community health financing and/or programming and implementers of large-scale community health programmes. The global interviews included institutional financiers of community health, community health researchers and normative agencies. These respondents were selected to represent those making community health policy and financing decisions in the selected REACHOUT countries, generating evidence to inform the decisions, and those affected by the decisions through involvement in translating policy to practice.

Data collection, management and analysis

Interviews were guided by a semi-structured topic guide, which was piloted in Kenya before use (available in Supplementary File S2). We asked respondents' questions about their community health experience, about domestic and external financing for community health in their setting, and, using quality improvement as a case example of a project, about evidence needs, evidence use, and financing mechanisms related to decision-making and the (community health) decision space.

In all cases except two in Ethiopia and two in Mozambique, interviews were conducted in English by the corresponding author. In those four interviews, local researchers with prior experience in qualitative methods and community health were trained in the interview content and objectives and conducted the interviews.

Thirty nine of 43 total interviews were digitally recorded and transcribed by local researchers in each country (where they were conducted in another language, they were transcribed in the local language and then translated); the remaining respondents asked not to be recorded and interviewer notes were included in lieu of a transcript. Code frame development was done deductively according to the objectives of the study: understanding decision-maker perspectives on quality and understanding the use of evidence in decision-making for community health financing and programming. Additional codes (particularly, detailed information around financing and economic evidence) were added inductively in the course of the analysis as they had arisen due to the open questioning style used in the interviews (Gale *et al.*, 2013) (for full code frame, see Supplementary File S3). Analysis was assisted by NVivo11 software, and for each theme, relevant quotes were examined to generate a draft narrative. A thematic framework approach was used for the analysis (Gale *et al.*, 2013). Given that there was a single lead researcher conducting interviews and coding, quality assurance was done in the following ways: (1) review of selected transcripts by senior authors; (2) coding workshop with colleagues where multiple individuals coded transcripts to ensure inter-coder reliability; and (3) discussions with and feedback from research partners/co-authors in each country on emerging themes. For non-recorded interviews, the notes were included as transcripts and coded in the same way as verbatim transcriptions described above; direct quotes from these interviews were not included due to the risk of misrepresentation of exact wording.

Results

Respondent characteristics

A total of 43 key informant interviews were conducted with purposively sampled respondents working in community health at national

Table 1 Sampling framework

Category	Possible respondents	Location	Eligibility criteria
Global funders and policymakers of community health	USAID, Global Fund, UNICEF, WHO, UN Special Envoy, Financing Alliance, DfID, Health Systems Global CHW TWG members	Global—mix of remote and in-person	Funders of cases identified in the literature review
National/sub-national CTC programme decision-makers	National Community Health Unit, National Division of Standards, District/County Community or Quality Focal Point, NGOs (as appropriate)	2–4 per country at relevant levels In-person	Identified by REACHOUT country teams Involved in: policy, financing, and/or programming decisions for CTC providers
Community health researchers and implementers	REACHOUT country Principal Investigator;Local academic or NGO-based researchers (international only if embedded)	2–3 per country In-person	Working on REACHOUT project for 3 or more years OR Researching CTC providers for 3 or more years

Table 2 Respondent characteristics[a]

Level/country	Programme policy	Programme financing	Researcher	Implementer/health worker	Total
Global	1	5	2	3	11
National/Ethiopia	3	1	1	5	10
National/Kenya	3	1	2	3	8
National/Malawi	2	2	1	3	7
National/Mozambique	2	1	1	4	7
Total			43		

[a]Respondents were allowed in exceptional cases to be included in more than one category or quota.

and global levels. In total, these were: global ($N = 11$), Ethiopia ($N = 10$), Kenya ($N = 7$), Malawi ($N = 6$) and Mozambique ($N = 6$); descriptions of respondents are shown in Table 2. There was a focus on policy and financing decision-makers, with the latter being over-represented at global level due to the predominance of external financing in this area. Implementers and health workers represent the individuals who translate decisions into practice/action and have a perception of how and if their evidence gets used in this process. Of the researchers, who represented a smaller proportion of the total sample, two were economists and the majority was working more broadly on implementation research, governance, feasibility and process evaluations in the CTC space.

Institutions represented at the global level included: UNICEF, World Health Organization; Global Fund to Fight AIDS, Tuberculosis and Malaria; Global Financing Facility for Women, Children and Adolescents; Last Mile Health; Financing Alliance for Health; United Nations' Special Envoy for Health; Community Health Impact Coalition; United States Agency for International Development; South Africa Medical Research Council; and John Snow International representing Maternal and Child Health Integrated Program; out of this group, implementers are those organizations that deliver community health programmes in country. Institutions represented at country level are national and sub-national government staff as well as non-governmental organizations (NGOs) and International Organisations as relevant to the community health planning, financing and delivery in each context.

Evidence use in national-level decisions for publicly funded programmes

The reported use of economic evidence in health policy and financing decisions varied by country but was generally informal and motivated by individuals instead of systems. Ethiopia demonstrated the most formalized processes and procedures for the use of economic evaluation in the health sector at the national level, with a separate department inside the Federal Ministry of Health's Planning Directorate responsible for using and assessing economic evidence (particularly finance data from National Health Accounts and evaluation data from Public Health Research Institute). No study countries systematically required the use of economic evidence in decision-making for as a formal stage in public policy or financing decisions for community health. Community health systems were, in the views of most respondents, an extension of the health system rather than a core part, evidenced in part by the title of CTC workers as 'extension workers' in some settings. As such, community health was viewed as a lower priority than other health areas in terms of commissioning evidence, and related decision-making was less restricted by formalized processes and requirements for evidence. In the absence of these governing structures, change was often described in our data as driven by individual leaders and/or the desire for political advantage instead of evidence, as in this case from Kenya:

> *I haven't seen anyone talking about an incremental approach [to policy change in community health]; I have just seen the type like Kitui [County] where you [leaders] decide today: 'I'm going to do this and I'm going to put this money'* (community health researcher, Kenya).

The most commonly available evidence of impact or benefits of community healthcare investments at national level, understood as programme performance by the majority of respondents, was generated by CTC health workers through routine monitoring and evaluation. However, these routine data were not thought by most to be reliable enough to support decisions; improving the quality of routine CTC data was considered by several respondents to be a prerequisite to its use. This was compounded by the fact that these data are often paper based (community data are reported in District Health Information Software 2 only in Kenya and Ethiopia, and even these are often incomplete), so the process of obtaining performance data from this source may have prohibitive time cost. A sub-national key informant in Mozambique told us of frustrations in trying to get and use routine community health programme data in their work:

> *The APE [or CHW] is producing data in a useful way but this information I feel that, I do not know where it is going because I do not have a report of what happens to 'my' information. I get a bit confused because there is no transparency of where [that] information goes. When I consult the Ministry, they say that it is used by the programmes, but we at the level of the province we do not feel that* (policymaker, Mozambique).

Few national-level respondents talked about using cost-effectiveness evidence to inform decisions, though in Ethiopia there were several who mentioned aspirations to generate their own cost-effectiveness data for projects and new programmes. The limited number who mentioned them stated that cost-effectiveness studies, where available, are not seen by national policymakers as addressing budget constraints, as they do not address real constraints on available financing. This was summarized by a respondent in the Federal Ministry of Health in Ethiopia as follows:

> *The results they submitted to us [show] if the implementing second generation is the extension program cost effective? But it needs really further discussion and also policy dialogue also with some stakeholders … it's more expensive … I think we need more data like for example if we implement second generation extension program all over the country how much cost it will take and the other thing what are the health gains in this amount of investment.*

In contrast, several respondents discussed costing data being used alone without effectiveness data. These data were used mainly to

fundraise, through approaches like gap analyses, and to decide whether to expand coverage of the CTC programme.[2] Despite expanding coverage or 'extension' of services being a stated aim of community health programmes in all study countries, no respondents directly stated a need for evidence on the equity of community health services. Respondents used 'coverage' to address primarily geographical equity considerations, but no direct mention was made of other aspects of equity. Healthcare workers in Ethiopia described the equity-linked challenges in their community work:

> *To work on quality, the problem we face is that patients are found in geographically difficult areas . . . so that makes problems to communicate with us.*

Among policy makers, there were several mentions of the challenge of allocating a limited budget across many interventions. Trying to achieve allocative efficiency is a potential entry for effectiveness evidence to identify the best investments. However, instead of providing incentives to focus on priority setting, allocation of resources was linked to coordination between funders and partners to cover the different aspects of comprehensive but unfunded annual plans. In this way, coverage sometimes meant avoiding the duplication of efforts in investments rather than increasing access to healthcare services. An implementer in Mozambique stated the challenges of prioritizing investment in community health in their planning processes simply:

> *[Access is prioritised over quality] – and this is linked to resources; if resources are slim and you have to go strengthen at the community level or the health facility level, what do you do?*

Evidence use in funding applications

The influence of external financing and donor priorities on community health decisions came out strongly in the data. In the study countries, external financing is a majority of the community health financing, yet it was seen as unpredictable and (often) having limited flexibility. A financing agency key informant in Kenya described the role of external financing on community health:

> *. . . the disadvantage of being off budget is you are working outside the system. Yeah, it's a parallel system which is unhelpful in many ways and complicates things. That's one of the causes why community health care is funding 'off budget' mainly and by donor funding.*

Each donor and their priorities were described as changeable and contingent on other fiscal planning and calendars—yet they put pressure on national government to adapt to and often adopt their priorities. For many national level key informants, the predominance of external financing brought about a lack of motivation and/or space to drive the agenda in their own health sector.

> *You see like right now say USAID has money and all their money goes to partners . . . the partners need to implement what USAID and government have agreed on; so theoretically that is what happens but we know mostly it is pushed by USAID and we follow that and because the counties just want the money, they will say: 'it's fine let's go ahead' . . .* (community health researcher, Kenya).

External financing was seen to limit the value of economic evidence to government staff; governments are desensitized to the full costs of these programmes and in some cases view the international priorities as 'pre-vetted' for impact. In addition, these programmes are often tightly earmarked and thus evidence becomes irrelevant until the project funding period is over. Externally funded NGO-led projects are often required to report programmatic costs, but governments are not directly trading off these investments against other possible programmes and the focus on sustainability is limited. Instead, the Ministries of Health are occupied with the coordination of programmes contingent on external funding cycles rather than driving implementation based on (local) evidence, as described in Mozambique:

> *I see that the Ministry of Health goes with this programme but at the same time they are not preparing themselves for taking over. They still rely on the partners; that is the big issue. This programme depends too much on the partners* (community health implementer, Mozambique).

Evidence use in priority setting for global financing and the role of global agendas on domestic financing

Globally, there is a stated or 'on paper' agreement about the need for evidence to underpin decisions, in part to address fairness concerns among those competing for financing. These fairness concerns were restated in calls by national-level respondents for transparency in financing decisions by global-level financing mechanisms. Despite this stated commitment, political processes and prioritization exercises precede the evidence-based decisions in several cases. For example, the initial allocation of funds to human immunodeficiency virus/acquired immune deficiency syndrome, tuberculosis and malaria for each country from the Global Fund is made according to a formula. Subsequently, community health, as a component of the health systems strengthening envelope within the country allocation, has to 'fight' for resources from these disease areas. Similarly, in the Global Financing Facility of the World Bank, the reasons for selection of the priority countries were opaque, according to this key informant:

> *How the 16 countries were selected, I'm not completely sure . . . well, partly it was our priority countries because there was a political economy angle to the countries from the donor side, so there's also these countries themselves who say they want . . . to be part of it so it will require they speak for themselves* (key informant, global).

The biggest global items influencing community health, UHC and the United Nations' Sustainable Development Goals for health were mentioned in each of the study countries by at least one respondent despite there being no direct question about it. Of the respondents who mentioned it, all national policy makers of funders of community health, several did not have a clear definition of UHC, potentially limiting its efficacy at motivating financing or policy shifts. However, they stated that pressure from global stakeholders towards UHC is increasing, without clarity what evidence would be needed to measure progress towards this global goal. The perceived relationship of UHC to economic evidence was limited and primarily related to access to financial protection for community members, as stated by a policymaker in Kenya:

> *. . . the Permanent Secretary and the Cabinet Secretary they were really looking at how community strategy can be used to reach people in the coverage of the National Hospital Insurance Fund.*

The evidence being generated to support these global agendas was perceived by the majority of respondents to focus predominantly on feasibility and impact evaluations of small-scale pilots and programmes in specific locations, sometimes called 'pilot-itis'. This led respondents to be concerned that the resulting evidence is not

relevant to other contexts, even within the same country. In those sites where CTC providers have greater curative responsibilities, particularly Ethiopia, respondents felt that a lot of community health evidence was not relevant to their 'highly skilled' CTC providers, so they tended to call for more 'local evidence'. Seemingly in contrast, in Kenya, national policymakers felt that devolution of decision-making to sub-national administrative units at county level might have led to the fragmentation of evidence needs, with demand for research and evaluation from each county.

Quality of care not a priority in the assessment of investments in community health

Quality of CTC care was usually termed 'performance' by respondents, and most respondents had low expectations of quality and performance. By the majority of respondents, CTC care was viewed as a means of expanding 'coverage', focusing largely on geographic barriers to care (e.g. >5 km to a health facility) rather than social, economic or other barriers to equitable health care. They viewed this as reasonable given the relatively simple tasks allocated to most CTC providers and their limited levels of education and formal health training. Community health financing decisions, both domestic and external, have similarly emphasized the requirement for geographic spread over quality, and this was also a focus of responses that equated coverage with quality, with no mention of 'effective coverage':

> *We've seen that they [the donor] are very much like we want a number of children immunised to be such and such; it's not about quality its really about numbers and coverage* (community health implementer, Ethiopia).

At the national level, decision-makers stated that the aspects of quality they would like to have evidence of included: improving health outcomes (in all countries), data quality (mainly Malawi and Kenya, with two mentions in Mozambique), ownership by and accountability of services to citizens (in all study sites except Ethiopia). Most stated that quality could be improved through better supervision and policy changes. In Ethiopia, respondents were more likely to mention health benefits in specific health areas and in some cases to describe meeting system-wide targets as a proxy for quality (e.g. quotas for percentages of deliveries attended by a skilled birth attendant). Across countries, evidence for improved quality that would be acceptable to participants included: changes in reporting rates for routine data on community health services, increased demand for services at primary healthcare facilities, decreasing burden of disease and CHW/community satisfaction. However, many national-level key informants acknowledged that quality was difficult and expensive to measure, as the challenges with routine data meant that understanding the quality of care was perceived to require additional, non-routine data collection. As such, most respondents also had limited expectations for evaluations to be able to incorporate robust evidence on quality.

The design and integration of quality management structures in the Ministries of Health appeared to influence the appetite for economic evidence examining quality or performance. In Ethiopia and Mozambique, quality was a small part of the job description of technical staff in well-funded disease departments (e.g. malaria). In contrast, in both Kenya and Malawi, healthcare quality and standards were managed by a stand-alone department, supporting dedicated staff who promoted the quality agenda in evidence and decisions across the sector. Yet in these countries, quality management staff were sometimes marginalized or excluded from decision-making due to a lack to technical health area focus, as shown in this example from Malawi:

> *That was our original plan to have quality improvement persons in each [technical] department; we have one meeting and then the directorate [of quality management] calling them but of course nobody showed up and that is the challenge these departments always have* (programme implementer, Malawi).

Yet even where there is an independent quality structure, getting that structure to consider the 'extension' of their mandate to community level could still prove a challenge, as continuing with the Malawi example illustrates:

> *They [the directorate of quality management] … initially they were saying—'why should we talk about the community?' and I said 'no, then you are joking'* (policymaker, Malawi).

The same was true in Kenya, where the national Kenya Quality Model for Health had not been functionally extended to the community level or even disseminated by the National Department of Quality and Standards.

Non-evidentiary influences on decisions

At the immediate decision level, almost every discussion came back to a combination of limited relevant evidence and limited capacity to use the evidence that exists. This limited capacity was described as leading to a lack of demand for evidence and limited resources dedicated to commissioning or generating evidence, creating a vicious cycle. It also creates a vacuum that advocates of particular approaches or programmes were described as filling with their own priorities, through power and their political savvy. Decision-makers try to juggle this influence alongside many other non-evidentiary limitations:

> *… the decision makers, are they able to use comparative cost analyses against different programme and make sort of an effectiveness decision, sort of that? And I think the answer is no, that they will only use the data for decision making not in a vacuum, there's like a million other constraints …* (community health implementer, global).

At the national level, the role of power over evidence appeared to be related to the degree of decentralization of the health sector, but this relationship was complex; decentralization was described as allowing space for more levels of 'politics and power', while also potentially increasing accountability due to proximity between voters and decision-makers, so it did not play out the same way in different locations but was dependent on individuals. Across the countries, contextual factors including varied responsibilities of community health workers, limited formal evidence consideration in most annual work planning procedures and complex interactions between Ministries of Health and of Finance were seen to influence the likelihood of evidence use in decisions. Similarly, a couple global respondents identified that where programmes were not nationally led (but rather NGO led), the geographic impacts would be piecemeal and may not be generalizable across the country.

Finally, interactions (i.e. power) and political viability were key to understanding decisions—both among global funders 'competing' for implementation space in priority countries and among national policymakers looking for re-election for themselves or their party, as well as between these global- and national-level actors. This links to the negative public opinion that faces national and sub-national decision-makers who try to use evidence to justify removing

established services, or to disinvesting, as this Ethiopian policymaker described:

> *Actually, it is very difficult for communities, for example some strategies being implemented for the last ten or fifteen years, the community is highlight dependent on that so there may be a resistance with the community [to stop funding something].*

Despite this, global (international and bilateral) influence on national priorities was consistently present in the data and continues in large part because it comes with financial support—and expectations of delivering on donor priorities.

Discussion

This multi-country analysis on the use of evidence in community health in LMICs highlights a gap around the use of economic evidence in financing and policy decisions. We find limited use of evidence in decision-making for community health and confirm findings from other studies that power and politics have noteworthy influence on priority setting. In explaining why evidence is not used, respondents described a lack of 'useful evidence', with available evidence perceived as not generalizable and not responding to the resource limitations on the ground, as well as limitations in capacity to evaluate and apply the evidence meaningfully. Due to a predominance of external financing of CTC programmes, national decision-makers are desensitized to the full costs of programmes. Donor priorities often fill the vacuum created by 'useful evidence' gaps, and this is reinforced by the unpopularity of disinvestment among constituents. CTC providers continue to be viewed as a means of increasing access to primary healthcare services; increased coverage of health services is the main benefits that decision-makers expect from investment in community health, with quality (or effective coverage) and equity largely absent from participant-identified evidence gaps.

Evidence use in community health programming is constrained and influenced by contextual factors unrelated to the relevance and quality of the evidence. We conceptualize the influences on such decisions as coming from three levels: micro, meso, and macro as derived from the results as shown in Figure 1 (Caldwell and Mays, 2012). In the inner circle or micro level, we show the 'ideal' of evidenced-based policy setting and implementation, including priority setting, evidence assessment, decision-making and financing.

At the meso level, we show the constraints on the ideal micro or decision level. The first constraint is environmental/epidemiological and service data availability and quality. At the meso level, routine community data quality is poor and most countries do not have

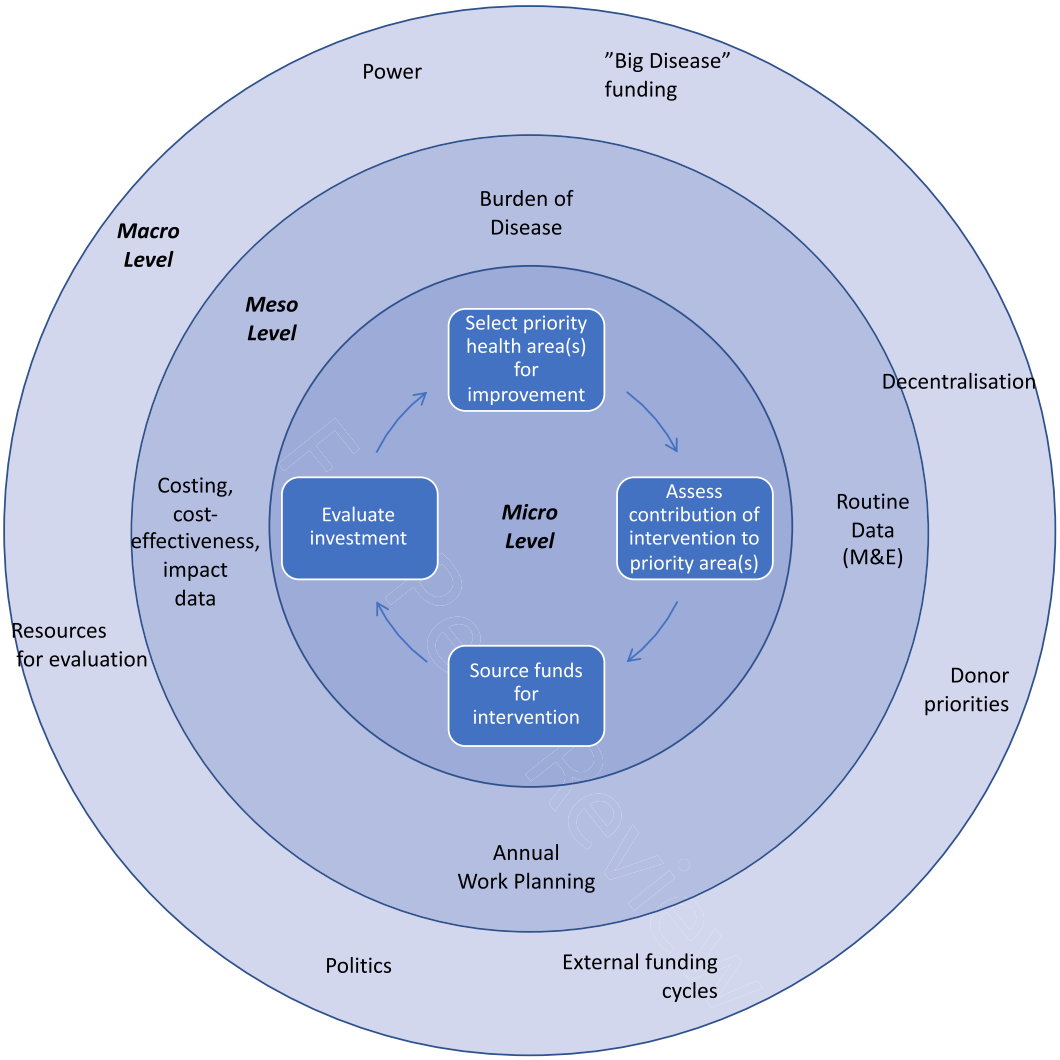

Figure 1 Conceptual framework for influences on community health programming decisions.

recent sub-national data on epidemiology and costs of interventions. The second constraint stems from a lack of processes and procedures (e.g. where annual work planning is done primarily related to historical expenditure and programming). Marginalization of community health from the 'formal' health system means fewer formalized procedural requirements for evidence use in decision-making and less commissioning of such evidence (in comparison with other health areas). Because of these limitations in community health in many countries, even where evidence exists, it is perceived as irrelevant and decision-makers are not encouraged to use it. The third limitation is capacity for evidence selection, understanding and use in community health decision-makers; this is a finding from consistent with wider studies in LMIC health systems (Stansfield *et al.*, 2006; Wickremasinghe *et al.*, 2016; McCollum *et al.*, 2018b,c; Vanyoro *et al.*, 2019). Comprehensive planning for community health programmes would involve decision-makers assessing an extensive set of routine data from health information systems that include: census, vital events, monitoring, public health surveillance, resource tracking, facility-based service statistics and household surveys (Stansfield *et al.*, 2006). Analysing these data, setting priorities and then aligning priorities to available resources are essential skills (Schneider and Nxumalo, 2017), and indeed in a recent study in Zambia, managers indicated that costing information highlighted priorities for more efficient use of resources in immunization programming (Feldhaus *et al.*, 2019). However, capacity strengthening around these transferable skills is rarely funded by vertical programmes, the main source of external financing for community health programmes (Conn *et al.*, 1996). Increased capacity could increase the appetite for evidence and could be reinforced by involving policymakers in research activities whenever possible and bringing them to the ground to see what 'impact' and 'benefits' means to workflows in the health system and livelihoods in the wider communities, potentially overcoming political barriers to evidence use, similar to what Schneider proposes related to community health governance (Schneider, 2010).

Finally, at the macro level or outer circle, decisions are influenced by health sector structures, decision and fiscal spaces, funders and their priorities (WHO, 2014; Katahoire *et al.*, 2015a,b; Greenhalgh *et al.*, 2017; Pfadenhauer *et al.*, 2017; Rajkotia, 2018). At the macro level, global institutions that finance community health programmes are more likely to formalize the use of economic evidence. However, as a result of the levels of external financing, priorities of global institutions then have an outsize influence on domestic agendas, delinked from local evidence and need in many cases.

Overall, this builds on the work of McCollum *et al.* from the Kenyan context showing that a lack of high-quality, relevant evidence and limited capacity to use it, compounded by external influences, allows power and politics to trump evidence use in many community health programming decisions (McCollum *et al.*, 2018c). We add the generalizability of these findings beyond priority setting and into non-devolved systems. In this conceptual framework, the different aspects highlighted at each level illustrate where and how evidence could be leveraged, if available, to overcome the role of power and politics in decision-making to improve the targeting of services and efficiency of the investments in health.

A core tenet of economics is that a decision-maker ought to take into account both the benefits of the intervention and the resources required to achieve those benefits and then to compare these relative to other potential investments and make a rational choice (Varian, 1992). Our findings that respondents do not perceive current cost-effectiveness studies to reflect their budget constraints suggest that, at a minimum, available studies do not accurately reflect the opportunity costs, perhaps due to inappropriate thresholds. Indeed, much critique of various thresholds (and in some cases, any thresholds at all) for cost-effectiveness has been levelled in the literature over the last 10 years (Newall *et al.*, 2014; Marseille *et al.*, 2015; Ochalek *et al.*, 2015, 2018; Woods *et al.*, 2016). In response to the push for UHC, the last 5 years have seen the development of a dizzying suite of investment cases, strategies targeting non-traditional donors and innovative approaches to promote consistent, sufficient financing of community health (Singh *et al.*, 2013; Global Financing Facility, 2016; Community Health Financing Compendium, 2017; Fernandes and Sridhar, 2017; Chou *et al.*, 2018; E&K Consulting, 2018; Community Health Roadmap, 2019). In most cases, this represents progress towards integration of community health into broader health systems, though priorities often continue to reflect donor concerns (likely in response to the fact that community health systems are still primarily funded by external financing in most countries). However, it is not clear who is the decision-maker that is intended to be influenced by many of these cases and studies. Many of them target that the Ministries of Finance and CTC programme leaders are rarely explicitly considered, nor are sub-national decision-makers, despite an increasing emphasis on decentralizing decisions in LMIC health systems (Bossert and Mitchell, 2011; Otiso *et al.*, 2017; McCollum *et al.*, 2018a; Abimbola *et al.*, 2019). For this powerful evidence to be used and useful, it must consider the decision-maker more explicitly and the constraints on their decision, e.g. through budget impact analysis rather than simply reporting incremental cost-effectiveness ratios against thresholds (Revill *et al.*, 2014; Bilinski *et al.*, 2017; Robinson *et al.*, 2017; Ochalek *et al.*, 2018).

As with any multi-country study and qualitative studies more generally, there are challenges to generalizability due to the contextual variation. However, the results were generally consistent enough to suggest actions for researchers and to commissioners and users of economic research evidence in the community health space. The selection of countries from within the REACHOUT consortium near the end of that programme period might have increased some of the key informants' consideration of and awareness of community health issues as part of the wider healthcare system in comparison to others in the region. The highly variation in degree of decentralization of community health decisions could have also created less convergence around evidence use. In terms of positionality, the collection of data by a non-local researcher might limit the willingness of some respondents (especially government staff) to be fully frank and, similarly, conducting interviews in English might have limited the nuance available to participants with more limited language proficiency.

Conclusions

In summary, there is ample room to improve and increase evidence use in community health programming and financing decisions. The goals of the health sector are in improving population health and health outcomes; additional benefits of improved quality of CTC health worker services are intrinsically valuable but even more complex to measure—aspects such as trust, motivation, inclusion and adherence. Thus, decision-makers focus on coverage as the priority benefit that they would like to see represented in evaluations of community health programmes, yet have limited resources to commission or undertake evaluations, and limited pressure to use the results. Politics further constrains decisions primarily in two ways:

first, hardware investments such as hospitals, vehicles and equipment are easy election 'wins', and second, removing established services that are less (cost-)effective is politically challenging, even if evidence exists. If researchers and community health decision-makers can bridge these gaps between them, the important value of evidence in improved community health programming and therefore improved population health will begin to be realized.

However, all potential approaches will have to overcome weaknesses in quality of available data, limitations in decision-maker capacity and concerns about applicability of evidence expressed by respondents in this study.

Notes

1. REACHOUT is a multi-country research consortium focused on the quality of community health that worked from 2014 to 2019 in six countries (Ethiopia, Kenya, Malawi and Mozambique in Africa and Bangladesh and Indonesia in Asia). For this piece of work, we focused on the African countries (for details on the community health programmes in the four study countries, see Supplementary File S1).
2. Expanding coverage was used to mean either adding human resources in existing sites or expanding geography of the programme.

Supplementary data

Supplementary data are available at *Health Policy and Planning* online.

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Appendix 11: Aggregated supplementary material from submitted Chapter 6 paper

Study sites

As stated in the main article text, the study sites included the following countries: Ethiopia, Kenya, Malawi, and Mozambique, in addition to global-level interviews. Each of these countries was selected for two reasons:

1. Incorporation of large-scale community health programs as part of the national UHC strategy; and
2. for their representation in the REACHOUT consortium as involved in community health action research in multiple sites or locations.

All countries have community health programs that are wholly or partially government-led. However, the typology of the community health workers (responsibilities, professionalization, remuneration, etc.), structure of the programs, and level of integration with the wider health care system was variable. In this supplementary material, we give a brief description of this variation to provide greater context for the findings. In each country, ethical approval was granted and details of these approvals can be found in Supplementary File 4 to the main manuscript.

Description of the community health systems in each study site

Descriptions of community health worker typologies tend to incorporate some or all of the following dimensions: responsibilities and relationship to community and health facilities, selection and recruitment, training and supervision, remuneration and supplies. These have been described in detail by many publications, including those of the REACHOUT consortium and by the author as part of earlier work (Lewin *et al.*, 2010; Kumar *et al.*, 2014; Mireku *et al.*, 2014; Nyirenda *et al.*, 2014; Give *et al.*, 2015; Kok *et al.*, 2015; Mahmud *et al.*, 2015; Kane *et al.*, 2016; Olaniran *et al.*, 2017; Tumbelaka *et al.*, 2018; Ormel *et al.*, 2019).

Supplementary file 1: Community health systems description

Here I provide a brief description of the community health worker typologies and systems in each study site as is relevant to understanding of the findings presented in the main manuscript; further details on the typologies of the CTC providers can be found the supplementary material to a recent publication by the author (Kumar *et al.*, 2019).

Ethiopia

In Ethiopia, community health is fully institutionalized under the Ministry of Health. The main professionalized cadre of CTC providers are an all-female group called health extension workers. By policy, they are selected by their communities and two serve each community (approximately 5,000 people) at any given time (Ministry of Health, 2007). They receive training of one year in 16 "essential packages", including preventive and curative care for maternal and child health, as well as hygiene, disease prevention, and health education. They serve the community from Health Posts as well as doing household visits. They are supported by unpaid CTC providers called the Health Development Army and 1-to-5 group leaders who are the heads of model households (Datiko *et al.*, 2019). Health Extension Workers are supervised by Health Centre staff, the lowest level facility of the primary care system in Ethiopia, and *woreda* or district staff also have less frequent supervisory role. Successes of the health extension programme in various sites and health service areas are well documented, though opportunities for improving the quality and consistency of care remain (Wang *et al.*, 2016; Assefa *et al.*, 2019).

Kenya

In Kenya, the community health strategy was established in 2006 and revised in 2014 (Republic of Kenya Ministry of Health, 2014). The current policy includes two tiers of community health workers: community health volunteers (CHVs) and Community Health Extension Workers (CHEWs), the latter of which was only officially included in the national scheme of service in 2013 (Republic of Kenya, 2013). Though are both officially recognized, only the CHEWs are salaried government employees. Recommended ratios are one community health unit per approximately

5000 population, to be staffed by 5 CHEWs and 10 CHVs. Main responsibilities of both cadres are preventive and promotive health, with a focus on maternal and child health outcomes. CHEWs are linked to a primary health care facility (Level 2 or 3) and will supervise the CHVs; supervision is also provided directly by the sub-county health management team. Given devolution of health policy and decision making to the county (sub-national) level in the new Kenyan constitution of 2010, county policies on pay for the two cadres and key responsibilities vary (McCollum *et al.*, 2016, 2018). There have been many pilots of utilising CHVs to deliver various curative services but few of these have made it to policy and practice (Christoffersen-Deb *et al.*, 2015; Mushamiri *et al.*, 2015; Otiso *et al.*, 2017; Onono *et al.*, 2018; Gimaiyo *et al.*, 2019).

Malawi

The Malawian Ministry of Health has recently issued a new community health policy, the subject of much fanfare in the global UHC community (Malawi, 2017). This policy focuses on the Health Surveillance Assistants (HSAs) and improving role clarity and support for them; next, the country is focusing on is using this evidence to mobilize resources for expanding coverage and ensuring salaries and commodities under the new plan (Davey *et al.*, 2016; Barger *et al.*, 2017; Greco *et al.*, 2017). HSAs are nominated by their community, serving a population of approximately 1000, and receive 12 weeks of training focused on preventive health, family health and environmental health/sanitation. The HSAs also supervise CHVs and are supervised by senior HSAs, as well as by Environmental Health Officers and Community Nurses based at their link Health Facility (Kok *et al.*, 2016, 2018). Reporting is done on Form 1A and summarized in Form 1B before being entered into the DHIS2 at the district level. Several papers have been published examining the poor data quality in this community health system and possible means to improve that (Admon *et al.*, 2013; Joos and Silva, 2016; Yourkavitch *et al.*, 2016).

Mozambique

In Mozambique, the community health programme is implemented by Agentes Polivalentes Elementares (APEs). Although founded in the 1970s, the programme had nearly died out and was recently revitalized in 2010-11 to create a salaried cadre of community health workers (MISAU, 2010, 2011). APEs can be male or female and are elected by their communities and receive four months of residential training; this has been observed to be a barrier to equitable participation by both genders and men represent the majority of APEs (Steege *et al.*, 2018). Most of the care APEs provide should be preventive and promotive, though when commodities are available they also do integrated community case management of fever or iCCM for children under five years old; referral is another important function they provide (Davlantes *et al.*, 2019; Give *et al.*, 2019). APEs are supervised by link facility staff and district health management teams, but this is intermittent (Ndima *et al.*, 2015).

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Selected questions from the discussion guide relevant to findings in this paper

Section A: General close-to-community experience

1. Describe broadly your experience with community health workers and programs. How long have you been working in this area? What makes you enjoy it? What are the biggest challenges?
2. What is the role of your organization in working with community health programs?
3. What is the quality of the community health services currently provided in the (geographic) areas where you work?

Section B: Financing CHWs

[NB: this may be public/national, public/sub-national, NGO, external funds; please ensure probing for domestic allocation e.g. between curative vs. preventive care, between different geography in the country, embedding of external programs into routine practice as well as applications to external donors]

4. Would you describe specifically any funding you give or generate related to community health.
    a. What is the evidence or information that underpins this decision? (priority setting)
5. Who applies for the funding and what is the application process like? How long does it take?
6. What is the decision-making process for funding CHW programs?
    a. Who decides and what criteria do they use?
    b. What is the evidence or information that underpins this decision?
    c. How do you decide where to give money (geographically)? Is this decided in advanced or based on applications?
7. Once a funding decision is made, how does the money get transferred? (Specifically: through domestic channels or through parallel programs/implementers?) Is this the same at all sites?

Section C: Case example of QI for CHWs

[NB: take QI for community health as a case example of a program or intervention that might be uptaken into routine practice and explore evidence needs, use, and possible financing mechanisms]

8. We touched briefly on quality of community health programs earlier. How do you understand the term 'quality improvement' in the context of community health?
    a. (*interviewers: ask for other groups make up the CH ecosystem):* How do you think communities see this? Supervisors/health systems? CHWs themselves?
9. Please describe any community health QI training and activities that you are an active participant in. If none, list any of which you are aware.
   For each:
    a. Please share how it is financed?
        i. If you are funding it, what made you fund QI?

    ii. Is there a cost share between partners on this work? Who are they?
    iii. What challenges were faced around costs?
    iv. *(If donor financed)* who led the proposal development?
  b. How do you evaluate the success of your QI program?
    i. Did you conduct any economic evaluation and if so could you share that information?
  c. What do you think could build on this in the future?
10. What are the benefits/outcomes/impacts you expect(ed) from any/this QI work with CHWs?
  a. On the individuals involved?
  b. On the institutions or facilities participating?
  c. On the system more broadly?
  d. Do you believe these changes will be sustained over the next 5 years? 10 years? Why or why not?
11. What evidence would you like to see that these benefits are being realized?
  a. Are there any examples you could share about how that evidence has been effectively presented to you or by you?
  Probe for documents/reports/evaluations and ask if they can be shared
12. What kind of change would be required to merit an (additional) investment of funds available to you in this area?
  a. What evidence would help you know that it was worth the investment?
  b. What degree of cost would be acceptable given that degree of change? – does QI deliver 'bang for your buck'?
  c. What do you view as competing with this type of intervention for financing?
13. What do you think are the cost implications of QI for CH?
14. Are you/Do you think national policymakers are interested in funding QI? Why or why not?
15. Other than financing, what would be required to achieve sustained change in this area?

Name	Sources	References	Created On	Created By	Modified On	Modified By	Color
coordination	20	48	19 Jan 2019 02:59	MBK	18 Mar 2019 11:09	MBK	
economic evaluation evi…	9	18	19 Nov 2018 05:23	MBK	18 Mar 2019 11:16	MBK	
evidence vs politics	12	19	10 Jan 2019 02:04	MBK	18 Mar 2019 13:00	MBK	
importance of EE at di…	5	6	10 Jan 2019 02:05	MBK	18 Mar 2019 11:46	MBK	
role of EE in policy fu…	7	9	10 Jan 2019 02:04	MBK	18 Mar 2019 12:58	MBK	
embedding	23	67	10 Jan 2019 02:06	MBK	3 Mar 2019 23:00	MBK	
CHS as part of health…	23	44	17 Jan 2019 05:53	MBK	18 Mar 2019 13:07	MBK	
discussion from quant…	6	7	10 Jan 2019 02:06	MBK	25 Jan 2019 09:09	MBK	
key stakeholders	10	13	10 Jan 2019 02:06	MBK	3 Mar 2019 22:59	MBK	
non-financial	23	33	10 Jan 2019 02:06	MBK	18 Mar 2019 13:13	MBK	
Equity	10	14	22 Jan 2019 02:42	MBK	18 Mar 2019 13:10	MBK	
Financing of CHS	18	48	19 Nov 2018 05:16	MBK	18 Mar 2019 13:00	MBK	
budget impact	1	2	18 Mar 2019 13:00	MBK	18 Mar 2019 13:01	MBK	
competition with QI fo…	19	27	10 Jan 2019 02:05	MBK	18 Mar 2019 13:04	MBK	
Cost-effectiveness	3	4	19 Nov 2018 05:19	MBK	18 Mar 2019 13:00	MBK	
Decisionmaker	12	22	19 Nov 2018 05:19	MBK	18 Mar 2019 11:16	MBK	
devolution	16	45	16 Jan 2019 23:41	MBK	18 Mar 2019 11:16	MBK	
Disinvestment	5	5	19 Nov 2018 05:19	MBK	18 Mar 2019 11:14	MBK	
Evidence for financing…	13	25	19 Nov 2018 05:19	MBK	18 Mar 2019 13:01	MBK	
external financing	15	40	25 Jan 2019 08:35	MBK	18 Mar 2019 12:59	MBK	
roles in financing of di…	24	51	14 Jan 2019 13:51	MBK	18 Mar 2019 12:59	MBK	
governance	1	1	3 Mar 2019 22:58	MBK	3 Mar 2019 22:58	MBK	
leadership	13	35	29 Jan 2019 08:04	MBK	18 Mar 2019 13:13	MBK	
parallel to health system	2	4	3 Mar 2019 22:52	MBK	18 Mar 2019 11:00	MBK	
QI for CHS	20	31	19 Nov 2018 05:16	MBK	18 Mar 2019 13:11	MBK	
Cases or examples of…	22	42	19 Nov 2018 05:16	MBK	18 Mar 2019 13:10	MBK	
community-facility lin…	18	32	19 Jan 2019 03:04	MBK	18 Mar 2019 13:07	MBK	
dissemination and lea…	3	4	18 Mar 2019 11:34	MBK	18 Mar 2019 13:14	MBK	
Evaluation of QI for CHS	7	10	19 Nov 2018 05:23	MBK	18 Mar 2019 13:02	MBK	
Perceived cost of QI f…	16	29	19 Nov 2018 05:18	MBK	18 Mar 2019 13:13	MBK	
Quality of CHS	24	58	19 Nov 2018 05:16	MBK	18 Mar 2019 12:55	MBK	
Accountability for qua…	12	13	19 Nov 2018 05:18	MBK	18 Mar 2019 11:05	MBK	
Measuring quality	26	55	19 Nov 2018 05:18	MBK	18 Mar 2019 13:08	MBK	

MoH structures for qu…	17	39	19 Jan 2019 02:56	MBK	18 Mar 2019 13:03	MBK
Patient experience or…	12	16	19 Nov 2018 05:18	MBK	18 Mar 2019 12:56	MBK
Policy for CHS	12	33	21 Jan 2019 12:48	MBK	18 Mar 2019 13:05	MBK
Supervision	22	47	14 Jan 2019 13:48	MBK	18 Mar 2019 13:13	MBK
task-shifting	13	16	19 Nov 2018 05:22	MBK	18 Mar 2019 10:52	MBK
targets and performance…	2	5	18 Mar 2019 11:41	MBK	18 Mar 2019 12:56	MBK
UHC agenda	22	44	10 Jan 2019 02:05	MBK	18 Mar 2019 13:10	MBK
Value of QI	10	15	10 Jan 2019 02:02	MBK	18 Mar 2019 13:14	MBK
Benefits of QI for CHS	29	119	19 Nov 2018 05:17	MBK	18 Mar 2019 13:13	MBK
Accountability benefit	3	3	14 Jan 2019 14:00	MBK	18 Feb 2019 04:58	MBK
Adherence benfit	3	3	14 Jan 2019 14:01	MBK	18 Mar 2019 11:31	MBK
Allocation efficienc…	6	6	14 Jan 2019 14:00	MBK	22 Jan 2019 02:48	MBK
Benefits they would…	2	3	10 Jan 2019 02:02	MBK	20 Jan 2019 13:19	MBK
client satisfaction	2	2	18 Mar 2019 11:17	MBK	18 Mar 2019 13:02	MBK
Competition benefit	2	2	14 Jan 2019 14:03	MBK	18 Feb 2019 04:59	MBK
Data quality benefit	12	21	19 Jan 2019 04:03	MBK	18 Feb 2019 13:08	MBK
Evidence of benefits	9	10	19 Nov 2018 05:17	MBK	18 Feb 2019 13:05	MBK
Health benefit	13	17	19 Jan 2019 02:54	MBK	18 Mar 2019 13:02	MBK
How can we measu…	0	0	10 Jan 2019 02:03	MBK	10 Jan 2019 02:03	MBK
Ownership benefit	10	11	14 Jan 2019 14:01	MBK	3 Mar 2019 23:00	MBK
What evidence would…	7	8	10 Jan 2019 02:03	MBK	26 Feb 2019 03:22	MBK

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